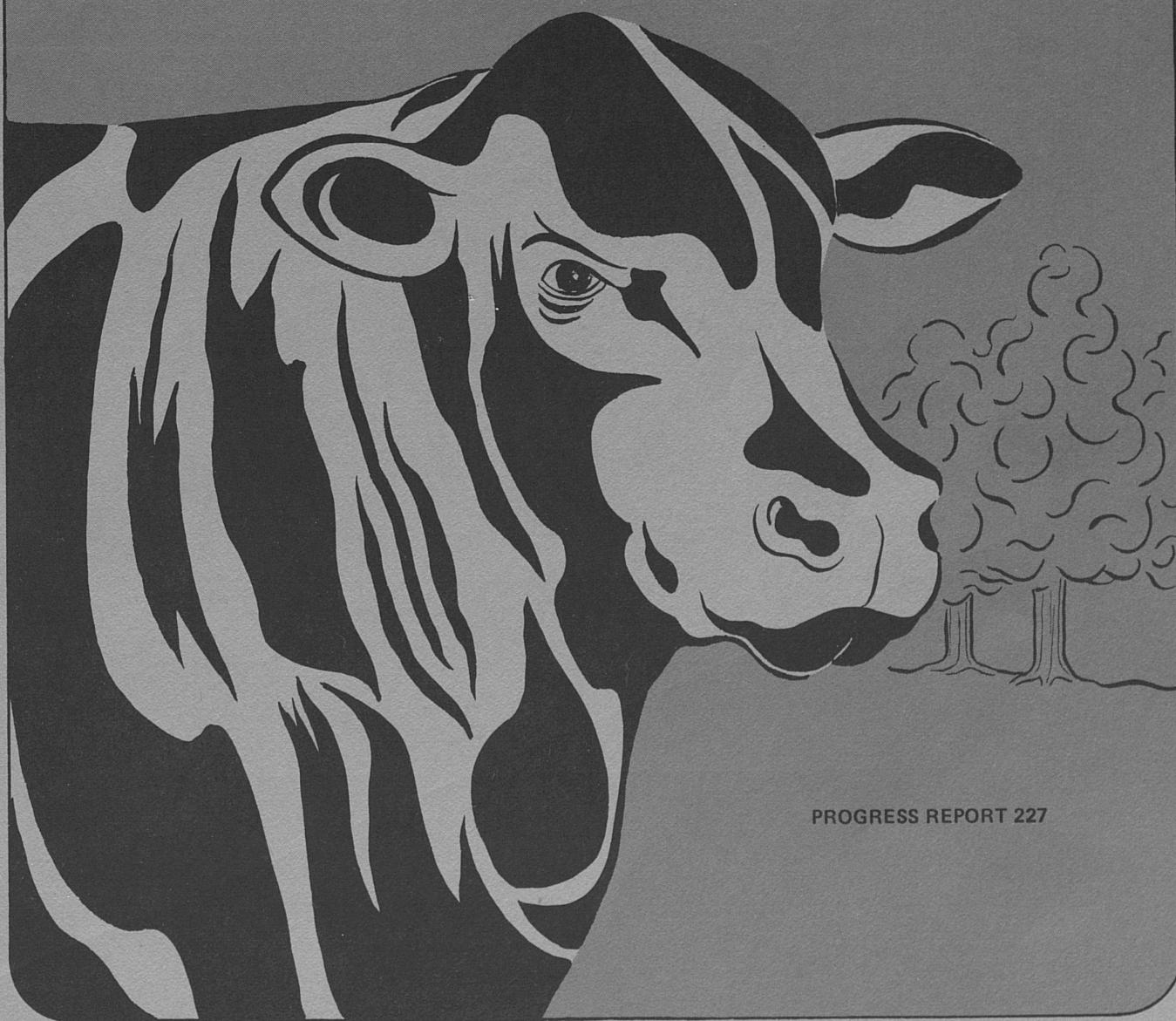


BEEF CATTLE RESEARCH REPORT—1977



PROGRESS REPORT 227

UNIVERSITY OF KENTUCKY • COLLEGE OF AGRICULTURE
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DEPARTMENT OF ANIMAL SCIENCES • LEXINGTON

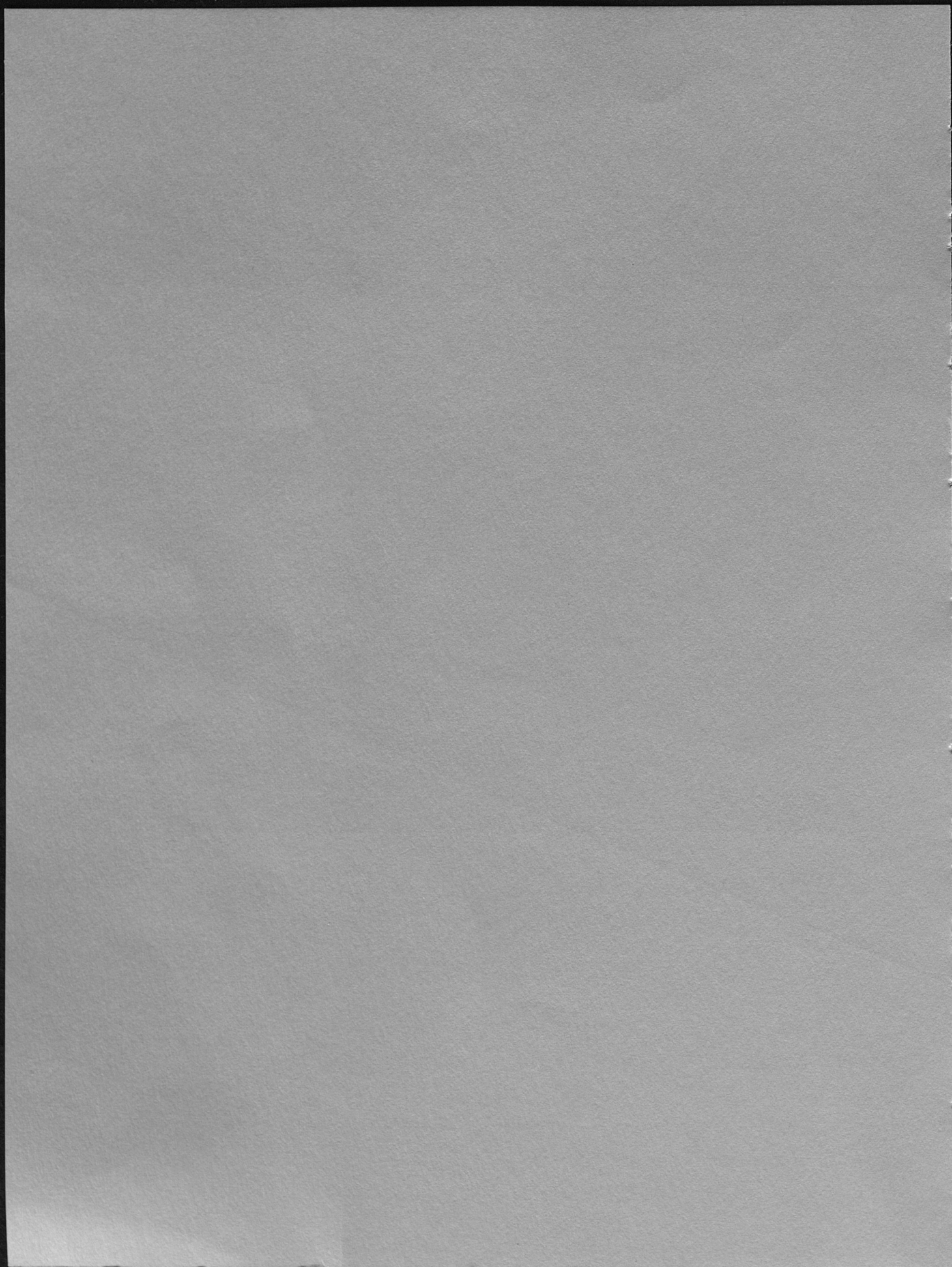


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KIND OF FORAGE, FORAGE MANAGEMENT AND CREEP FEED FOR SPRING-CALVING COWS AND CALVES

N. W. Bradley, D. R. Lovell, J. A. Boling and Nelson Gay

Kentucky 31 fescue and Kentucky bluegrass are both important cool-season grasses in Kentucky. A four-year experiment summarized in 1975 (Kentucky Agricultural Experiment Station, Progress Report 218) showed that fescue-clover pastures produced more total feed during the year, but bluegrass-clover pastures were of higher quality.

Pastures were stocked at the rate of one cow and calf for each two acres and any surplus forage was harvested as hay. During the four year period, the fescue-clover pastures yielded almost three times as much hay as the bluegrass-clover pastures. Cows on the fescue-clover pastures also required about 21% less hay during the winter, indicating that fescue-clover pastures also provided more feed during the winter than bluegrass-clover pastures. The higher quality of bluegrass-clover pastures was reflected by 48 pound heavier weaning weight of calves.

Further evidence of quality of pasture was that creep feeding calves on bluegrass-clover pastures resulted in a 38 pound heavier weaning weight; whereas creep feeding on fescue-clover pastures resulted in weaning weights which were 72 pounds heavier than non-creep fed calves. If the goal of a cow-calf producer is maximum weaning weight, this can be achieved by using bluegrass-clover or by creep feeding on fescue-clover. Creep-fed calves grazing fescue-clover pasture had weaning weights only 14 pounds lighter than creep-fed calves grazing bluegrass-clover.

In view of the greater amount of feed produced from fescue plus the fact that it is by far the most used cool-season grass in Kentucky, further research on management options seems justified. The experiment reported here included the following variables:

Kind of grass	1. fescue 2. bluegrass
Forage management	1. grass-nitrogen 2. grass-clover
Creep feed	1. none 2. cracked corn

The experimental design is shown in table 1. A total of 120 Angus cows and calves were used each year for a three-year period. Two acres of pasture were used for each cow and calf and surplus forage was harvested for hay. Eight groups of 15 cows and calves each were assigned to the eight different experimental treatments. Each group of 15 cows and calves was assigned to a 30-acre pasture. The pasture was subdivided into four 7.5 acre pastures to permit rotational grazing. An attempt was made to keep the pastures of high quality by clipping seed heads, weeds and forage which had been refused immediately following removal of cattle from the pastures.

Grass pastures were fertilized with about 140 pounds of actual nitrogen applied in split applications in March and August. Grass-clover pastures were seeded each March with two pounds per acre of Ladino clover. A chain harrow was then used to spread manure piles and as an aid in getting the clover seed in contact with the soil to assure better germination.

Cows were bred May 20 to July 20 and calves were born during March and April. Calves were weaned in October at about 220 days of age. Calves were removed from the experiment at weaning,

Table 1. Experimental Design

	<i>Kentucky 31 Fescue</i>		<i>Kentucky Bluegrass</i>	
	<i>Nitrogen</i>	<i>Ladino Clover</i>	<i>Nitrogen</i>	<i>Ladino Clover</i>
No Creep	15*	15	15	15
Creep	15	15	15	15

*15 cows and calves for each of the eight treatments

but cows remained on the experimental pastures throughout the year. When supplemental feed was needed during the winter, cows were fed hay which had been harvested from the pastures to which they were assigned. In the case of bluegrass-clover, total hay produced was not sufficient to meet the demands of cows on this treatment and bluegrass-clover hay was obtained from other sources. In addition cows were given extra energy in the form of ground corn for approximately a two-month period beginning about the middle of February. Corn was fed at the rate of 3.5 pounds per cow daily. A source of calcium, phosphorus and salt was also available at all times. During the winter feeding period, a mixture of 6 parts salt, 3 parts magnesium oxide and 1 part vitamin A concentrate (30,000 IU/gram) was offered free choice. In a further attempt to prevent grass tetany, 2 ounces of magnesium oxide per cow daily were included in the corn which was fed for about a two-month period beginning two weeks before calving started.

Calves assigned to the creep feeding treatments were given cracked yellow shelled corn on a free choice basis. Calves were offered the creep feed from May 20 until weaning.

Cows were reallocated each spring following the calving season and before breeding started on May 20. An attempt was made to equalize sire of the calf, sex of the calf and age of the cow.

Pasture samples were taken during the period of May and June and again during September from each pasture each year. The average composition of pastures is given in table 2. In the category of "other grass", most of the other grass in the fescue pastures was bluegrass with a lesser amount of orchardgrass. Most of the other grass in the bluegrass pastures was orchardgrass with a lesser amount of fescue. Obviously an attempt to eliminate the bluegrass from areas to be seeded in fescue by spraying with herbicide before fescue was seeded was not completely successful.

Table 2. Pasture Composition (3-Year Average*)

	<i>Kentucky 31 Fescue</i>		<i>Kentucky Bluegrass</i>	
	<i>Nitrogen</i>	<i>Clover</i>	<i>Nitrogen</i>	<i>Clover</i>
Bluegrass, %	----	----	87.0	42.6
Fescue, %	72.4	53.7	----	----
Clover, %	0.5	18.1	4.2	20.6
Other Grass, %**	21.3	22.2	4.5	16.8
Weeds, %	5.0	5.9	4.5	20.0

*A total of 20 samples was taken for each of the pastures over a 3-year period.

**Includes any fescue present in the bluegrass pastures and any bluegrass present in the fescue pastures.

Table 3 gives the three-year average performance data of calves. Using the standard adjustments for age of dam, sex of calf and 205 days, weaning weights of calves were affected by the experimental treatments as follows:

1. Increased 88 lb. by creep feeding on fescue.
2. Increased 51 lb. by creep feeding on fescue-clover.
3. Increased 39 lb. by creep feeding on bluegrass.
4. Increased 38 lb. by creep feeding on bluegrass-clover.
5. Increased 33 lb. when grazing bluegrass compared with fescue.
6. Increased 23 lb. when grazing bluegrass-clover compared with fescue-clover.
7. Increased 36 lb. when grazing fescue-clover compared with fescue.
8. Increased 26 lb. when grazing bluegrass-clover compared with bluegrass.

Table 3. Three-year Average Performance of Calves

	<i>Fescue Nitrogen No Creep</i>	<i>Fescue Nitrogen Creep</i>	<i>Fescue Clover No Creep</i>	<i>Fescue Clover Creep</i>	<i>Bluegrass Nitrogen No Creep</i>	<i>Bluegrass Nitrogen Creep</i>	<i>Bluegrass Clover No Creep</i>	<i>Bluegrass Clover Creep</i>
No. Calves	45	45	45	44	45	45	45	44
Birthweight, lb.	68	70	68	67	67	68	67	69
Age at Weaning, days	226	219	224	223	221	225	221	223
Actual Weaning wt., lb.	487	563	521	574	507	560	526	579
Adjusted Weaning wt.*, lb	472	560	508	559	505	544	531	569

*Adjusted for age of Dam, Sex of Calf and 205 Days

Table 4 shows that calves grazing fescue pasture used their creep feed much more efficiently than calves on fescue-clover, bluegrass or bluegrass-clover. If it is reasoned that creep feeding corrects a nutritional deficiency, obviously there was more of a nutritional deficiency for calves grazing fescue pastures. Calves on fescue pasture may not have consumed as much of the fescue or the fescue may have been more deficient in digestible energy than the other pasture forages. Another consideration is that dams of calves on fescue pasture may not have provided as much milk for their calves. It seems obvious that there was more of a nutritional deficiency for calves grazing fescue and that creep feed corrected the deficiency resulting in much better utilization of creep feed compared with the other three pasture treatments.

Cow weight changes during the period May 20 to October 30 for the four different pastures are shown in table 5. Cows grazing fescue-clover gained 32 pounds more during this period than cows grazing straight fescue and cows grazing bluegrass-clover gained 60 pounds more than cows grazing straight bluegrass. Cow gains for cows grazing either bluegrass or fescue were similar, with only a 17 pound difference in favor of bluegrass. Cows grazing bluegrass-clover pasture gained 45 pounds more than those grazing fescue-clover. Although cows on the bluegrass-clover treatment were carrying considerably more flesh at the time the calves were weaned, all cows appeared healthy and apparently body weight gain was adequate for all cows.

Table 4. Efficiency of Creep Feed*

	<i>Kentucky 31 Fescue</i>		<i>Kentucky Bluegrass</i>	
	<i>Nitrogen</i>	<i>Ladino Clover</i>	<i>Nitrogen</i>	<i>Ladino Clover</i>
Adj. weaning wt.				
Creep, lb.	560	559	544	569
Adj. weaning wt.				
No creep, lb.	472	508	505	531
Gain due to creep, lb.	88	51	39	38
Creep per calf daily, lb.	4.7	4.6	4.4	4.3
Creep per calf, lb.	761	745	713	695
Creep/lb. added gain, lb.	8.6	14.6	18.3	18.3

*Calves received creep from May 20 to October 30.

Table 5. Cow Weight Changes - Preweaning

	<i>Kentucky 31 Fescue</i>		<i>Kentucky Bluegrass</i>	
	<i>Nitrogen</i>	<i>Ladino Clover</i>	<i>Nitrogen</i>	<i>Ladino Clover</i>
No. Cows	90	90	90	90
Initial Wt., lb.*	1066	1036	1042	1073
Average Wt., lb.	1083	1069	1068	1128
Final Wt., lb.**	1100	1102	1093	1184
Cow Gain, lb.	34	66	51	111

*Initial weight - May 20

**Final weight - October 30

No reproductive problems were experienced for cows on any of the different pasture treatments. It has been reported that conception rate is often considerably lower for cows grazing straight fescue. Possible reasons why no reproductive problems occurred in this study is feeding 3.5 pounds of corn for a two-month period beginning two weeks before calving, pasture management with respect to rotational grazing and clipping and the fact that about 20% of the available herbage in the fescue pastures was other grasses which was largely bluegrass.

The effect of creep feeding calves on cow weight changes during the last 163 days before weaning is not clear. Table 6 shows that cows grazing either fescue or bluegrass, with creep fed calves gained more than cows grazing the same pastures with calves which were not creep fed. However, cows

grazing either fescue-clover or bluegrass-clover with creep-fed calves gained less than cows grazing the same type of pasture with non-creep fed calves.

Table 6. Effect of Creep Feeding Calves on Cow Weight Changes

	<i>Kentucky 31 Fescue</i>		<i>Kentucky Bluegrass</i>	
	<i>Nitrogen</i>	<i>Ladino Clover</i>	<i>Nitrogen</i>	<i>Ladino Clover</i>
Calves Creep Fed				
No. Cows	45	45	45	45
Initial wt., lb.*	1103	1019	1091	1046
Avg. wt., lb.	1126	1044	1119	1094
Final wt., lb.**	1149	1070	1147	1139
Cow Gain, lb.	46	52	56	93
Calves No Creep Feed				
No. Cows	45	45	45	45
Initial wt., lb.*	1028	1054	992	1101
Avg. wt., lb.	1040	1094	1015	1165
Final wt., lb.**	1051	1133	1038	1230
Cow Gain, lb.	23	79	46	129

*Initial weight - May 20

**Final weight - October 30

The amounts of feed fed during the winter to cows on each of the four different kinds of pastures are given in table 7. It can be generalized that cows grazing fescue or fescue-clover pastures were fed hay for about one-half as many days and were fed less than one-half as much total hay as cows grazing bluegrass or bluegrass-clover pastures. Since the total amount of feed fed is considerably below the National Research Council's allowances for dry pregnant cows, pasture made a significant contribution to cows on all four pasture treatments.

Table 7. Winter Feeding of Cows

	<i>Fescue Hay</i>		<i>Bluegrass Hay</i>		<i>Ground</i>
	<i>Fescue</i>	<i>Fescue</i>	<i>Bluegrass</i>	<i>Bluegrass</i>	<i>Corn*</i>
	<i>Nitrogen</i>	<i>Clover</i>	<i>Nitrogen</i>	<i>Clover</i>	<i>All Cows</i>
No. days fed	54	64	107	110	69
Rate, lb./cow/day	6.8	5.9	6.8	7.7	3.5
Total/cow, lb.	367	378	728	847	242

*Corn was fed from February 15 to April 25

Table 8 gives the amount of surplus pasture harvested as hay. Fescue and fescue-clover was more productive than bluegrass and bluegrass-clover by about 26 tons. The grass-nitrogen treatment also resulted in about 35 tons more pasture harvested as hay than the grass-clover treatment. It is realized that hay yields are low and it should be pointed out that the demand for grazing had preference over an attempt to get maximum hay yields. At times some fields were grazed for a while and then the surplus forage was harvested in the form of hay. It is also realized that legumes such as red clover or alfalfa would improve yield of hay. In this study, surplus forage was harvested as hay to better measure total pasture productivity.

Table 8. Hay Production

Year	<i>Fescue Nitrogen</i>		<i>Fescue Clover</i>		<i>Bluegrass Nitrogen</i>		<i>Bluegrass Clover</i>	
	<i>Acres</i>		<i>Acres</i>		<i>Acres</i>		<i>Acres</i>	
	<i>Cut</i>	<i>Tons</i>	<i>Cut</i>	<i>Tons</i>	<i>Cut</i>	<i>Tons</i>	<i>Cut</i>	<i>Tons</i>
1974	45.5	26.0	-----	-----	38.0	10.6	13.4	2.5
1975	45.5	92.5	45.5	55.0	45.5	74.0	45.5	48.5
1976	38.0	24.5	-----	-----	13.4	11.6	-----	-----
Avg.	43.0	47.7	15.2	27.5	32.3	32.1	19.6	17.0

The practice of creep feeding has been a controversial subject for some time. In the final analysis whether to creep feed may be determined by the goal of the cow-calf producer. The higher price of feed grain in recent years makes creep feeding less attractive to the commercial producer. Also, if a producer keeps his calves after weaning, he may be more concerned with total efficiency of production with respect to the cow, calf and the pasture rather than maximum weaning weight. On the other hand, the goal of a purebred producer may be to fully measure the genetic makeup of calves through performance testing. In this case, creep feeding the calves may be advisable rather than providing extremely high quality pasture which will fatten the cow excessively.

Whether to make a grass pasture more productive by applying nitrogen fertilizer or by introducing legumes into the grass stand is a management option to be contended with by Kentucky cattlemen. Commercial nitrogen will increase productivity and the resulting pasture may be somewhat easier to manage. Pasture productivity can also be increased by adding legumes and the legumes also improve the quality of the pasture so that faster rate of gain of cattle result. In this case, cost of production, quantity and quality of pasture as well as pasture management must be considered.

With respect to kind of grass, results of this experiment showed fescue to be more productive, but bluegrass to be of higher quality relative to rate of gain of cows and calves. In the final analysis the goals of each producer will determine the specific details of his pasture and herd management program.

RUMENSIN FOR GROWING, FINISHING CATTLE

N. Gay, N. W. Bradley and J. A. Boling

Monensin sodium (Rumensin[®]) is a biologically active compound produced by the microorganism *Streptomyces cinnamonensis*. Rumensin has been found to improve the utilization of feed at various energy levels including all forage or hay rations. Generally, the feeding of Rumensin has resulted in reduced feed intake. However this effect has depended on the level of Rumensin fed and the energy concentration of the ration. This reduced feed requirement and feed intake has been attributed to the influence of Rumensin on fermentation patterns in the rumen.

Acetic and propionic acids are produced in the rumen as end products of carbohydrate digestion. On rations high in roughage, acetic acid predominates while high energy or grain rations result in relatively less acetic and more propionic acid being produced. Rumensin causes a shift toward propionic acid which is produced and utilized more efficiently from the standpoint of energy conversion. After a certain level of propionic acid is reached, cattle have a reduced appetite. Therefore the most efficient levels of Rumensin for different ration combinations is an important aspect of cattle feeding which needs to be determined.

Rumensin is presently approved for use in feedlot rations. It will likely be approved for use with grazing cattle when sufficient data is available. A withdrawal period is not necessary since no residues have been found following slaughter of Rumensin fed cattle. Various studies with Rumensin have been conducted by UK researchers, some of which are reported here. Results show in general that Rumensin saves 10-15% in feed required per unit of gain. Its influence on rate of gain is not as consistent as its influence on improved feed utilization, but growth gains can be expected to be improved and finishing gains not influenced to a very great extent.

MONENSIN LEVELS FOR STEER CALVES GRAZING PASTURE

J. A. Boling, N. W. Bradley and L. D. Campbell

Seventy-two Angus steer calves were utilized in a grazing trial to determine the influence of level of monensin on rate of gain. They were randomly allotted to 4 treatment groups of 18 steers each. The 4 treatment groups were: (1) control, (2) 25 mg, (3) 50 mg and (4) 100 mg monensin per head daily. The monensin was mixed with ground shelled corn and fed at a level of 0.91 kg per steer daily. The 4 groups of steers were randomly assigned initially to four 4.86 hectare pastures containing a Kentucky bluegrass-clover mixture. The steers were rotated weekly among the 4 experimental pastures for the duration of the grazing period.

The initial weights and average daily gains are presented in table 1. Steers which were fed 25 mg monensin per day had the same gains as the control steers. Steers fed 50 mg or 100 mg monensin per head daily had higher average daily gains than those fed either no monensin or 25 mg monensin per head daily. These data indicate that improved gains in growing cattle can be expected by feeding 50 or 100 mg monensin per head daily during the summer grazing period.

Table 1. Body Weights and Average Daily Gain of Steers Fed Different Levels of Monensin Throughout the Grazing Period^a

	<i>Level of Monensin/day</i>			
	<i>Control</i>	<i>25mg</i>	<i>50mg</i>	<i>100mg</i>
No. steers ^b	18	17	18	18
Initial wt., kg	209.4	212.6	209.8	211.5
Final wt., kg	287.3	289.0	311.7	307.2
ADG, kg	.55 ^c	.55 ^c	.73 ^d	.68 ^d

^aLength of the trial was 140 days (May 4 to October 23)

^bOne steer died in the 25 mg treatment group.

^{cd}Means on the same line bearing different superscripts differ significantly ($P < .01$).

MONENSIN LEVELS FOR FINISHING STEERS FED CORN SILAGE DIETS

J. A. Boling, N. W. Bradley and L. D. Campbell

Ninety-six Hereford and Charolais-crossbred steers were utilized in a study to determine the influence of level of monensin on growth and feed efficiency of finishing steers. The steers were randomly allotted to 12 groups of eight steers each. The 12 groups were randomly assigned to 4 treatments of 3 pens per treatment. The 4 treatment groups were fed the grain supplement presented in table 1 in which monensin replaced corn to provide the following levels of monensin per 4.54 kg of grain supplement: (1) control, (2) 100 mg, (3) 200 mg or (4) 300 mg monensin per steer daily. In addition, they were offered corn silage *ad libitum*.

Table 1. Composition of Grain Supplement Fed to Finishing Steers

<i>Ingredient</i>	<i>Percent</i>
Ground shelled corn	86.3
Soybean meal (44% C.P.)	8.6
Urea (45% N)	1.6
Dicalcium phosphate	2.5
Salt	1.0
Vitamin A ^a	+

^aVitamin A was added at a level to provide 20,000 IU per 4.54 kg grain supplement.

Growth and feed efficiency of steers fed different levels of monensin for the 157-day trial are presented in table 2. Steers fed all levels of monensin had small nonsignificant increases in average daily gain. Feed intake decreased slightly as level of monensin fed increased. Feed efficiency was improved by all levels of monensin fed. Also, a small improvement in feed efficiency was observed as the level of monensin fed was increased from 100 mg to 300 mg monensin per head daily. The improved feed efficiency is consistent with that observed in many other studies with finishing cattle.

Table 2. Growth, Feed Intake and Efficiency of Steers Fed Different Levels of Monensin^a

	<i>Level of monensin/day</i>			
	<i>Control</i>	<i>100mg</i>	<i>200mg</i>	<i>300mg</i>
No. steers	24	24	24	24
Initial wt., shrunk (kg)	302.0	300.2	303.7	300.4
ADG, kg	1.14	1.26	1.23	1.18
Corn silage/day				
(dry matter), kg	4.13	3.64	3.31	3.00
Grain suppl/day				
(dry matter), kg	4.05	4.03	3.99	3.90
Feed/gain (dry matter basis)	7.26 ^b	6.08 ^c	5.92 ^c	5.88 ^c

Carcass data collected at the termination of the trial are presented in table 3. Carcass weight, U.S.D.A. grade, yield grade and dressing percentage did not differ significantly among the four treatment groups of steers.

Table 3. Carcass Characteristics of Steers Fed Different Levels of Monensin (157 Days)

	<i>Level of Monensin/day</i>			
	<i>Control</i>	<i>100mg</i>	<i>200 mg</i>	<i>300mg</i>
Carcass wt., kg	298.8	308.3	304.6	293.6
U.S.D.A. grade ^a	9.5	9.5	9.0	8.5
Yield grade	2.2	2.5	2.5	2.3
Dressing %	62.3	61.4	61.3	60.5

^aU.S.D.A. grade. 9 = good -, 10 = good, 11 = good +.

EFFECTS OF DIFFERENT RUMENSIN LEVELS ON FEEDLOT CATTLE

W. W. Steen, N. Gay, J. A. Boling, N. W. Bradley,
J. W. McCormick and L. C. Pendlum

Decreased feed intake, improved feed efficiency and gain responses as a result of feeding Rumensin has been reported by various researchers. Results are uniform, with respect to improvement in feed efficiency; however, gain response is variable depending on ration composition and level of Rumensin. In general the effects of Rumensin on carcass traits have been minimal.

The purpose of this study was to: (1) observe the response of feedlot steers to Rumensin level; (2) observe the effect of altering the level of Rumensin based on feed intake; (3) determine the effect of Rumensin on carcass traits and liver abscesses.

Ninety-six crossbred yearling steers were randomly allotted to four treatments on the basis of weight and breeding. The levels of Rumensin were as follows: A-control; B-100 mg; C-200 mg; and D-variable levels depending on feed consumption as follows: initially, 150 mg until day 28 of the trial; then 200 mg until day 56; followed by 250 mg until day 84 and finally 300 mg Rumensin per head daily until termination at day 183.

The control ration consisted of corn silage fed to appetite, ground shelled corn, initially fed at four pounds per head daily and increased to an average final level of 8.4 pounds (dry matter basis) per head daily, and soybean meal (44%) fed at 1.33 pounds, Salt, trace mineralized salt and steamed bone meal were fed free choice. The Rumensin treatments were the same as the control except for the additions previously described. Initial full and shrunk weights were obtained, as well as full weights every 28 days throughout the experiment. These were used in adjusting feed intake and Rumensin level.

At the start of the study, all cattle were implanted with 36 mg DES, wormed, vaccinated for IBR, P1₃, leptospirosis and injected with vitamins A, D and E. Following 183 days on feed, cattle were slaughtered at a cooperating packing plant and carcass data obtained following a 48 hour chill.

Feed intake, feed efficiency and daily gains are shown in table 1. Steers fed either 200 mg or the variable level of Rumensin consumed less corn silage and less total ration than the control or 100 mg groups. Feed efficiency was improved by all levels of Rumensin, the 200 mg level giving the greatest improvement. The average feed saving due to Rumensin was 12%. All Rumensin fed groups had significantly greater average daily gains than the control group.

Carcass data are presented in table 2 and showed no difference in dressing percent or incidence of liver condemnations. Rumensin fed steers had significantly heavier carcasses, more internal and external fat. Quality grade was not influenced, however, yield grades were different due to fatter carcasses.

Table 1. Effect of Rumensin Levels on Dry Matter Intake, Daily Gains and Feed Efficiency

Item	Treatment (mg Rumensin/hd/day)			Variable
	0	100	200	
No. steers	30	30	30	30
Avg. start. wt., lb.	528	524	521	517
Avg. end. wt., lb.	942	970	986	968
ADG, lb.	2.27	2.46	2.53	2.46
Avg daily ration, lb.				
Corn silage	10.1	9.8	9.2	9.1
Ground corn	6.6	6.7	6.7	6.6
Soybean meal	1.3	1.3	1.3	1.3
Total dry matter	18.1	17.8	17.3	17.1
F/G	8.0	7.2	6.8	7.0
% of Control	-----	92	85	88

Table 2. Effects of Rumensin Levels on Carcass Characteristics

Item	Treatment (mg Rumensin/hd/day)			Variable
	0	100	200	
Dressing %	63.4	63.3	63.6	63.2
Hot carcass wt., lb.	596	614	627	612
U.S.D.A. quality grade ¹	7.3	7.5	7.2	7.9
U.S.D.A. yield grade	2.8	3.1	3.1	3.2
Liver abscesses %	20	10	20	33

¹quality grades, good + = 6, Choice - = 7, Choice ° = 8

HIGH AND LOW LEVELS OF CORN AND WHEAT WITH AND WITHOUT RUMENSIN IN FEEDLOT RATIONS

N. Gay, J. A. Boling, N. W. Bradley, D. Lovell, J. R. Overfield
and W. R. Selman

Since the relative price of feed grains and fed beef vary over time, the response of finishing cattle to different kinds and levels of grain with and without Rumensin needs to be clarified. Previously reported studies of this type have not used wheat as a ration ingredient. The objective of this study

was to determine the response of feedlot cattle to different levels of corn and wheat, with and without Monensin.

A total of 192 yearling steers were used in two experiments at two locations. Corn was fed at two levels at one location and wheat at two levels at another location. Rumensin was fed at 0 and 300 mg per head per day across grain levels, after the initial 28 days, during which time 100 mg was fed.

Cattle were crossbred, yearlings in medium flesh, which had been accustomed to their respective rations prior to the start of the study. Within each experiment, 96 cattle were allotted to 12 pens of 8 each on the basis of weight and breed. Each animal was implanted with 30 mg of DES, wormed, vaccinated for IBR, P1₃, leptospirosis, blackleg and malignant edema, and injected with vitamins A, D and E.

Cattle were weighed initially, full and following a 24-hour fast, and at 28 day intervals thereafter. Ration adjustments were made on the basis of 28-day weights and feed consumption was calculated at corresponding times. Following final full and shrunk weights, cattle were transported to a packing plant for slaughter and collection of carcass data.

Rations consisted of corn or wheat, whole plant corn silage and soybean meal, Salt, trace-mineralized salt and steamed bone meal were offered free choice in a 3 compartment feeder. Grain levels were adjusted to 1% or (a full feed) 1.6% of liveweight. Soybean meal was fed at 1.0 and 1.5 pounds daily with the wheat and corn rations, respectively. All rations were fed once daily and adjusted to allow *ad libitum* intake. Wheat was coarse cracked and corn ground. Rumensin was added at 0 or 300 mg to the soybean meal, after the first 28 day period and at 0 or 100 mg during that time.

Rumen samples were taken just prior to termination of the 140 day studies via stomach tube and analyzed for total and molar percent, of individual volatile fatty acids.

Carcass data were collected following a 48 hour chill. Percent kidney, pelvic and heart fat was visually estimated. Quality grades were determined by a U.S.D.A. grader and yield grades were calculated from fat thickness, ribeye area, carcass weight and percent kidney, pelvic and heart fat.

Performance and feed data for corn fed cattle are presented in table 1. Gains and final shrunk weights were influenced by only one treatment, low grain control. Rumensin with low grain resulted in gains equal to high grain. Both grain levels and Rumensin levels resulted in significantly different daily dry matter intakes. Low grain treatments ate more TDN on the average. The high-grain Rumensin fed cattle ate less than non-Rumensin fed cattle. Feed efficiency was improved more on the low grain treatment by Rumensin, 17 vs. 3%.

Wheat fed cattle performance and feed data is seen in table 2. Again, final shrunk weights were significantly lower for the low grain control treatment. Rumensin fed with the low grain level resulted in gains similar to high grain without Rumensin. In this trial, grain level did not influence dry matter intake. Rumensin fed cattle consumed significantly less dry matter than non-Rumensin fed. This resulted in 8.5 and 14.2% improvement in feed utilization due to Rumensin in low and high grain treatments, respectively.

Carcass data for corn fed cattle are presented in table 3. No differences were noted except a lower hot carcass weight for low-grain control cattle.

Carcass data for wheat fed cattle, seen in table 4, also revealed no differences except for hot carcass weight. Higher grain level treatments tended to be fatter.

Observations on ruminal VFA production are seen in tables 5 and 6. A significant reduction in acetic and a concurrent increase in propionic acids were seen for both grain and Rumensin additions. Neither grain nor Rumensin additions influenced total VFA production.

Table 1. Influence of Grain Levels and Rumensin on Performance and Feed Efficiency

	<i>Corn Ration</i>			
	<i>LGC</i>	<i>LGR</i>	<i>HGC</i>	<i>HGR</i> ¹
No. steers	24	24	24	24
Initial wt., lb.	719	719	717	719
Final wt., lb.	997	1027	1030	1014
ADG, lb.	1.96	2.20	2.24	2.11
Avg. daily ration (Dry matter, lb.)				
Corn	7.04	7.06	12.91	12.32
Corn silage	12.91	11.88	6.34	5.15
Supplement	1.33	1.33	1.33	1.33
Total	21.27	20.26	20.57	18.79
F/G	10.80	9.21	9.17	8.90
% improvement	-----	14.7	-----	2.9

¹ LGC = low grain control, LGR = low grain + Rumensin, HGC = High grain control, HGR = high grain + Rumensin

Table 2. Influence of Grain Levels and Rumensin on Performance and Feed Efficiency

	<i>Wheat Ration</i>			
	<i>LGC</i>	<i>LGR</i>	<i>HGC</i>	<i>HGR</i> ¹
No. steers	24	24	24	24
Initial wt., lb.	733	741	737	733
Final wt., lb.	1003	1032	1032	1043
ADG, lb.	1.94	2.07	2.09	2.20
Avg. daily ration (Dry matter, lb.)				
Wheat	7.04	7.00	12.03	11.59
Corn silage	10.08	9.72	5.28	5.08
Supplement	.90	.90	.90	.90
Total	18.0	17.6	18.2	17.6
F/G	9.3	8.5	8.7	8.0
% improvement	-----	8.6	-----	8.0

¹ LGC = low grain control; LGR = low grain + Rumensin; HGC = High grain control; HGR = High grain + Rumensin

Table 3. Influence of Grain Level and Rumensin on Selected Carcass Traits

	<i>Corn Ration</i>			
	<i>LGC</i>	<i>LGR</i>	<i>HGC</i>	<i>HGR</i> ¹
No. steers	24	24	24	24
Hot carcass wt., lb.	618	640	649	642
Quality grade ²	7.04	7.00	7.42	7.21
Yield grade	2.99	3.16	3.24	3.12
Dressing %	62.4	62.3	63.0	63.3

¹ LGC = low grain control, LGR = low grain + Rumensin, HGC = high grain control, HGR = high grain + Rumensin

² Choice ° = 8, choice + = 9

Table 4. Influence of Grain Level and Rumensin on Selected Carcass Traits

	<i>Wheat Ration</i>			
	<i>LGC</i>	<i>LGR</i>	<i>HGC</i>	<i>HGR</i> ¹
No. steers	24	24	24	24
Hot carcass wt., lb.	625	645	647	653
Quality grade ²	7.21	7.17	7.42	7.08
Yield grade	3.13	3.25	3.74	3.60
Dressing %	62.4	61.8	62.9	62.6

¹ LGC = low grain control; LGR = low grain + Rumensin, HGC = High grain control, HGR = High grain + Rumensin

² Choice ° = 8, choice + = 9

Table 5. Influence of Rumensin and Grain Level on Ruminant VFA Production

<i>Corn Ration</i>				
<i>Treatment</i>	<i>Molar % VFA Concentration</i>			<i>Total VFA</i>
	<i>C₂</i>	<i>C₃</i>	<i>C₄</i>	<i>mM/1</i>
<i>Low Corn</i>				
Control	66.6	22.0	11.4	57.8
Rumensin	61.0	30.5	8.5	56.3
<i>High Corn</i>				
Control	61.2	26.5	12.3	61.7
Rumensin	59.9	31.8	8.3	57.4

Table 6. Influence of Rumensin and Grain Level of Ruminant VFA Production

Wheat Ration				
Treatment	Molar % VFA Concentration			Total VFA
	C ₂	C ₃	C ₄	mM/1
Low Wheat				
Control	66.4	25.7	7.9	37.6
Rumensin	59.7	33.9	6.3	35.9
High Wheat				
Control	60.9	31.8	7.3	36.6
Rumensin	55.9	37.6	6.9	46.8

ACIDOSIS OF FEEDLOT CATTLE

Lyndon N. Irwin, G. E. Mitchell, Jr., R. E. Tucker
and G. T. Schelling

Most programs for producing slaughter cattle include the feeding of high levels of grain for some period prior to slaughter. Because of the nature of the steer's digestive tract, the grain must be added to the diet carefully in order to avoid digestive disturbances. Such disturbances may also occur in cattle accustomed to grain under certain circumstances. Recent research at the University of Kentucky has been concerned with some of the problems which may occur when cattle and sheep consume excessive amounts of diets high in readily fermentable carbohydrates (grains).

The rumen of the steer contains large numbers of microorganisms (bacteria and protozoa) which normally assist the animal in the digestion of foodstuffs that it otherwise could not digest. If a ruminant consumes a large amount of grain when it has not been accustomed to such an easily digestible feed, the microorganisms begin to produce acids (primarily lactic acid) very rapidly. Lactic acid is usually broken down rapidly after its production, but in this instance the acid is produced faster than it is broken down. Therefore, as the acid accumulates, the pH of the ruminal contents decreases. The pH is normally neutral or only slightly acidic (6.5-7.0) when cattle consume all roughages and 5.5-6.5 when they consume a high grain diet. However, when cattle have consumed too much grain, the pH may drop below pH 5 as the acid accumulates. When the pH drops this low, the animal will generally refuse to eat or go "off-feed". This is especially common when the ruminal pH drops to 4.0 to 4.5. Then the cattle are likely to refuse some or all of their feed for several days.

Examples of some of the data which have been obtained at the University of Kentucky following overconsumption of an easily fermented carbohydrate are presented in table 1. Sheep were used as research models in many of the experiments because the reactions in the sheep rumen are similar to those which occur in the steer rumen. The changes in ruminal pH and lactic acid concentrations are obvious. Another rather consistent observation has been an increased hematocrit. The hematocrit refers to the percentage of the blood which is made up of red blood cells. During off-feed acidosis, the hematocrit usually increases, indicating a loss of fluids from the blood. This is actually due to the passage of fluids from blood into the digestive tract, eventually resulting in dehydration of the animal. It appears that dehydration may be a major factor leading to death during acidosis. Other commonly observed symptoms in addition to feed refusal have included extreme diarrhea, decreased urine production and lameness. The lameness observed includes bunching of the feet, humped back and reluctance to move. The temperature of the foot is warmer than normal. The front feet are most often affected, but symptoms may be observed in all four feet.

Many of the animals which recover from off-feed acidosis will later exhibit unusually rapid hoof growth which is referred to as chronic laminitis or founder. After recovery from the initial off-feed acidosis symptoms and after the cattle are re-started on feed, the gains of the foundered cattle (except for very extreme cases) are often similar to the gains of the cattle which do not show any symptoms of founder. Weight losses during acidosis, time off-feed and the time required to start the cattle on feed again may be important sources of economic losses in feedlots in which acidosis is a problem.

Toxins such as histamine and tyramine have been reported to be produced during acidosis. However, data do not consistently support this theory.

Off-feed acidosis has resulted from overfeeding most of the feed grains that are commonly used in this country. Wheat is considered the most dangerous feed grain from the standpoint of acidosis.

Table 1. Changes During Induced Lactic Acidosis in Ruminants

<i>Hours after Feeding</i>	<i>Ruminal pH</i>	<i>Ruminal lactic acid mg/ml</i>	<i>Hematocrit % RBC</i>
0	7.0	0.2	39
12	4.5	6.3	52
24	4.4	5.7	55
36	4.1	9.4	52
48	4.7	8.6	44
60	6.0	4.7	43
72	6.3	2.0	41

Consequently, its addition to cattle finishing diets should be made with extra caution, and cattle should be observed closely for signs of digestive disturbances.

It is important not to become complacent after cattle have been successfully started on a high grain ration, because consumption of excessive amounts of grain may still result in acidosis. This occurs most often after cattle have run out of feed for a few hours and the bunks are then refilled allowing cattle to consume unusually large amounts of ration or when a weather change causes the cattle to stay away from the feedbunks for several hours. Off-feed acidosis sometimes occurs when cattle are changed from a full-feed by hand to a full-feed in a self-feeder (Elam, 1976). This occurs due to cattle which have been consuming feed in competition with animals above themselves in the social order suddenly finding an unlimited supply of feed available. There have also been instances when cattle which have just been purchased are put into a feedlot with cattle that are already accustomed to the grain diet. Since these cattle are not accustomed to a grain diet, acidosis may be expected.

Since off-feed acidosis is ultimately a problem of microbial origin, there has been interest in attempting to alter the microbial population with antibiotics. Antibiotics are known to inhibit some of the lactic acid producing bacteria which are present in the rumen. However, pre-feeding antibiotics presently cleared for use in feedlot cattle has not prevented cattle acidosis and the method chosen may affect the amount of lactic acid produced. Work with corn has indicated that less lactic acid was produced at any one time and the pH remained higher when steers were fed whole shelled corn as compared to ground, steam flaked and high moisture corn (Johnson *et al.*, 1974). Some of the newer methods of grain processing such as flaking, extruding or expanding tend to increase starch availability (Prasad *et al.*, 1975) and therefore, lactic acid production may be more rapid.

The most effective method of avoiding off-feed acidosis in feedlot cattle is through proper management. This first involves introducing grain to cattle properly. When cattle are first brought into the feedlot from pasture they should be fed a starter diet consisting of at least half roughage. The diet should then be slowly changed, by substituting more grain for roughage until the desired ration composition is reached. This will usually take about three weeks. Sometimes, cattle may be received which have already been accustomed to a high grain diet. Such cattle will probably be hungry when they arrive and may consume too much grain if a high concentrate diet is offered. Therefore, it is safer

to offer these cattle a ration which contains more roughage than the one they have been fed previously. The percentage of grain can then be increased to its former level during the next week. If cattle which are accustomed to a high grain diet should happen to run out of feed for several hours, it is best to let them fill up once with a ration containing more roughage than they have been accustomed to before they are given access to the high concentrate diet.

Keeping these factors in mind when starting and maintaining cattle on high concentrate diets should enable the cattle feeder to avoid many of the problems of off-feed acidosis and founder.

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IMPROVING KENTUCKY FORAGES BY USE OF BETTER MANAGEMENT

J. Kenneth Evans and Garry Lacefield

Kentucky is a forage producing state. Seven million of the state's 15 million acres of agricultural land is in hay, pasture and silage crops. Potential studies show it is possible to have 9 million acres of forages if all land was used according to the best capabilities. This forage provides the base for the livestock industry. Although there is a lot of forage, there are some forage problems which must receive attention.

PROBLEM - Average Yields Are Too Low!

Pastures yield an average of about 1.0 ton per acre. They should be yielding at least 3.0 tons per acre. Clover and mixed clover grass hay averages 1.8 tons per acre, but research has shown there should be 4.0 tons per acre. Alfalfa hay yields average only 3.0 tons when they should be getting 5.0 tons per acre. Corn silage yields are also low with an average of 15.5 tons when they should be 20 tons per acre.

SOLUTIONS:

Better land use: Land should be used for the highest producing crops which it will support. There is a potential for about 2 million acres of alfalfa and only about 188,000 acres are grown. Over 2 million acres of clover-grass hay could be grown and only about 800,000 acres are grown. Alfalfa acreage should be increased to 10 times the present level and clover acreage should be at least doubled. These legumes would supply from the air the nitrogen which is necessary for good growth.

Proper establishment and management of adapted varieties: Soil testing, applying needed lime and fertilizers, using recommended varieties and high quality certified seed, using proper amount of seed, seeding on time with proper seeding techniques to give correct soil-seed contact and controlling pests are all important in obtaining good stands for improved production and higher quality forages.

More lime and fertilizer should be used: Less lime and fertilizer are used on forage crops every year in Kentucky. This results in low yields per acre and less efficient production. In 1958 Dr. E. N. Fergus summarized the results of 20 years research at the University Research Station at Princeton. Comparisons were made between pastures which were limed and fertilized according to soil test and those which were not limed and fertilized. Over the 20 years, it cost only 1/3 as much per pound to produce beef where lime and fertilizer were used as it did where no lime and fertilizer were added. This efficiency is needed more now by beef and dairy producers than ever before.

PROBLEM - Too Much Low Quality Feed Is Harvested!

Rainfall makes hay harvesting difficult in Kentucky, but waiting for that "good" hay making weather allows hay crops to become too mature. As they mature, fiber goes up and digestibility goes down. Grasses and legumes lose digestibility at the rate of 1/2% per day for each day they remain uncut past boot and bud stages respectively. Also, total yield is reduced because leaves are being lost at the bottoms of the plants faster than new ones are being added at the tops.

SOLUTION:

The best forage farmers in Kentucky try to get first cuttings of grass hay at about boot to early bloom stage of maturity. Established stands of alfalfa and red clover are cut at very early bloom,

which occurs in early May over most of the state. This requires them to cut hay before they set tobacco but in most years this really isn't a problem because tobacco plants aren't usually ready in early May anyway.

This early cutting of hay not only results in higher quality hay, but it also increases per acre total yields. When the first cutting is removed, the second cutting begins to grow. Early cutting gets the second growth started about 30 days earlier so an extra cut is possible. Also, if the first cut is taken early, second growth starts when there is moisture in the soil and temperatures are favorable for growth of cool season species.

PROBLEM - Forages Are Poorly Utilized!

Most forages grow most rapidly in early spring. Generally pasture growth is more rapid than livestock can keep grazed down so they trample down growth and waste it. Red clover is generally cut only once or twice for hay - even in fields that are not pastured. Feeding losses are extremely high when big bales and stacks are fed with no racks or wire to restrict cattle access to them.

SOLUTION:

Graze small fields in the spring and make hay or silage from surplusses. This may require electric fences splitting big fields or it may require closing gates so cattle can't go all over the farm. Cut red clover more times during the year. If it is used for hay only, established stands can be cut 3 or 4 times. If it is cut for hay and grazed, it can be grazed 3 or 4 times. Feed hay—especially the big bales and stacks—inside a rack, or behind an electric wire or other barrier which will keep cattle off of the hay.

SUMMARY

From 1965 to 1975 the livestock population (all cattle and calves) in Kentucky increased from 2.5 million to 3.99 million head. Forage production over the same period increased at a less rapid rate. Although only a few of the forage problems have been discussed here, they are extremely urgent, since all relate to efficiency of producing livestock and livestock products. Attention must be given to increasing yields per acre, improving quality and marketing, as meat or milk, all the forage produced.

BACKGROUNDING GUIDELINES

Curtis Absher, John Johns and Russell BreDahl

Backgrounding is a relatively new term that refers to the grouping and growing of beef calves from the time they are weaned until they are put on a finishing ration, usually in confinement. Backgrounding rations generally have a high forage to grain ratio.

Backgrounding offers several opportunities to Kentucky producers: (1) Cow-calf producers can expand their beef enterprise by selling more pounds without increasing cow numbers, (2) farmers with the ability to produce high quality forage can market it through cattle without maintaining a breeding herd and (3) cattlemen with special abilities can convert mismanaged calves into useful feeder animals.

Most successful backgrounders expect to add at least 300 pounds to the initial weight of calves purchased. Considerable weight gain is of economic importance because: (1) the costs of buying, treating and other overhead expenses are spread over more pounds than when lesser gain is achieved, (2) if negative price margins are experienced the real economic gain has to come from positive feeding margins.

Rate of gain should also be of concern to the backgrounder. As average daily gain increases the overhead cost and feed for maintenance are reduced per pound of gain. Therefore, more rapid daily gain is associated with lower costs per pound of gain. On the other hand cattle that gain rapidly enough to begin to fatten may be discriminated against at selling time. While the level of gain at which feeders begin to fatten is dependent upon the genetic makeup and previous management over fatness should not be a problem if the average daily gain is no greater than to 1.75 to 2.0 pounds.

With rations balanced to produce gains of 1.25 to 1.75 per day 170 to 240 days are required to put on 300 pounds of gain. Therefore, 1 1/2 to 2 groups of cattle should be fed per year if a producer wished to keep his facilities fully occupied. Some of the major pitfalls of backgrounding programs are:

- (1) Mortality and morbidity can be high on light weight calves during disease outbreaks.
- (2) Severe negative price margins can be encountered.
- (3) High quality forage is essential! If it is not available supplementation costs can be high.
- (4) Heifers, unless they are purchased at light weights can be pregnant.
- (5) Backgrounded calves need frequent and regular surveillance. Sickness often follows weaning

or shipping by two to four weeks—after it is thought the cattle are started on feed and are completely healthy.

Physical feed requirements and management suggestions for backgrounding calves to achieve about 300 pounds of gain follow:

I. Physical Requirements

Recommended lot area

Unsurfaced lot	- 400 sq. ft. per animal
Partially surfaced lot	- 150 sq. ft. per animal
Surfaced lot without shelter	- 55 sq. ft. per animal
Surfaced lot with open housing	- 35 sq. ft. per animal

Resting area in sheds or under shade

Calves up to 600 lb.	- 15 to 20 sq. ft. per animal
From 600 lb. until marketing	- 20 to 25 sq. ft. per animal

Recommended corral specifications

- Holding pens - 20 sq. ft. per mature animal
- Crowding pens - 150 sq. ft. per truckload
- Working chute - 18 to 30 ft. long, 21 to 24 in. max width
- Sorting alleys - 10 to 12 ft. wide

Recommended feeder space

- a. When all animals eat at one time
 - Calves up to 600 lb. - 20 in. per animal.
 - Yearlings - 24 in. per animal
- b. When feed is always available
 - Roughage ration - 6 in. per animal
 - Roughage and grain - 6 in. per animal
 - Grain and supplement - 4 in. per animal
- c. Self feeding
 - Calves - 4 in. per animal
 - Yearlings - 6 in. per animal

Recommended feed bunk dimensions

	CALVES	YEARLINGS
Height of top of bunk	20-24"	24-30"
Depth of bunk	6-8"	8-10"
Width (fed from 1 side)	24"	24-30"
Width (fed from 2 sides)	36"	36-40"

Watering Space

- 40 head per water space in drylot
- 15 gallons of water per head, daily

Concrete aprons along feed bunks and waterers

- 8 to 12 feet wide along bunks, 4 to 6 inches thick and sloping 1 inch per foot away from the bunk for self cleaning
- Pave an area extending 10 feet out from waterers

SAMPLE DAILY RATIONS

400 Lb. Animal

<u>Ingredients</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Grass Hay	7.65			
Mixed Hay		8.16		
Legume Hay			8.81	
Corn Silage				25.76
Corn	2.76	3.11	2.95	
Supplement, 40%	1.35	0.50		1.65
Expected ADG	(1.4)	(1.4)	(1.4)	(1.6)

500 Lb. Animal

<u>Ingredients</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Grass Hay	8.82			
Mixed Hay		9.48		
Legume Hay			10.07	
Corn Silage				31.30
Corn	3.86	4.18	3.95	
Supplement, 40%	1.33	0.36		1.72
Expected ADG	(1.5)	(1.5)	(1.5)	(1.7)

600 Lb. Animal

<u>Ingredients</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Grass Hay	9.93			
Mixed Hay		10.46		
Legume Hay			11.21	
Corn Silage				33.61
Corn	5.08	5.67	5.07	1.33
Supplement	1.27	0.17		1.75
Expected ADG	(1.6)	(1.6)	(1.6)	(1.8)

III. Total Feed Requirements (based on rations in section II)

<u>Type of Forage</u>	<u>Tons of Forage</u>	<u>Pounds of Corn</u>	<u>Pounds of Supplement</u>
Grass Hay	0.88	770	250
Mixed Hay	0.93	850	70
Legume Hay	1.00	890	-----
Corn Silage	2.65	75	200

*Note: Quantities in section II and III are based on forages of "average" values. Feeders should obtain forage analyses on their own feed and balance rations accordingly.

IV. Suggestions for Receiving Cattle to be backgrounded.

- Before cattle are started on feed
 - Arrange for overhead shelter for calves.
 - Have lots and buildings clean.
 - Arrange for close confinement until all cattle find feed and water.
 - Be able to supply 10-15 gallons of fresh water per head per day.
 - Provide a pen where sick animals can be kept separate from the group.
 - Provide adequate bunk space of correct height.
 - Provide working pens and restraint equipment.
 - Establish a working relationship with a veterinarian. Vaccinate calves for protection against feedlot diseases according to recommendations of your veterinarian at least three weeks prior to confining the calves.
- First day of confinement
 - Weight cattle.
 - Implant with growth stimulant
 - DES - 24 mg./hd.
 - Ralgro - 36 mg./hd.
 - Synovex - prepackaged dose
 - Let water tank overflow to draw cattle to water if the cattle are not accustomed to drinking from a tank.
 - Scatter some hay on the ground around feed bunks and also in the bunk to draw the cattle to the bunk.
- Starting cattle on feed
 - A complete receiving ration containing adequate roughage, energy, protein, minerals and vitamins is preferred for starting calves.
 - If grain is to be hand fed, start with 2 pounds of grain plus 1 pound of supplement per head on the second day. Increase grain at the rate of 1/2 pound per day until the cattle are consuming the desired amount.

4. Management Procedures (Day one for fresh cattle, after rest for stressed cattle)
Treat cattle for grubs. (Before October 31). Use a recommended pour-on, spot-on or spray.
Worm cattle using either a bolus, drench or an injection.
5. Castrate and dehorn
Inject with Vitamin A.
Vaccinate for Blackleg, Malignant Edema, Leptospirosis; also other clostridium diseases and viruses as prescribed by a local veterinarian.
Throughout the feeding period.
Keep fresh water and feed available. Discard stale feed, or feed it to the cow herd.
Check cattle carefully several times a day.
Isolate sick animals, and use a veterinarian.
Keep feeders and waterers out of the mud.

V. Determining the possibility of profit

Returns per head (assuming 35¢ /lb. gain)

Cost at 400 pounds, \$/cwt.	Selling price (at 700 pounds), \$/cwt.			
	30	35	40	45
35	-\$35	-\$0	+\$35	+\$70
40	- 55	-20	+ 15	+ 50
45	- 75	-40	- 5	+ 30
50	- 95	-60	- 25	+ 10

Every \$1 change in the cost per cwt. of gain is responsible for \$3 change in returns per head.

SHEEP AND CATTLE: COMPANION GRAZING FOR INCREASED PROFIT

D. G. Ely and B. P. Glenn

In Kentucky, pastures and forages are a major contribution to the production of meat, milk and fiber. Grass-finished beef and lamb have been a significant contribution to the meat animal industry for several decades. As a result, pastures should be utilized efficiently for maximum profit. The individual producer always has the potential to increase his profits if he is grazing his cattle. How? . . . The answer is companion grazing of sheep with cattle to give more return per acre. Sheep and cattle do go together. Research indicates that grazing sheep and cattle together on the same pastures can result in more production than grazing either species by itself. Let's take a look at some of the reasons why.

Sheep - Forage Efficiency

Sheep lead all farm animals in being able to produce marketable products on forage alone. It is also known that sheep are more efficient than cattle in utilizing rations high in forage content. Besides being an efficient forage converter themselves, sheep effectively compliment cattle grazing in how and what they graze. First of all, sheep have many advantages as grazing animals. The sheep's mouth is sufficiently small and narrow with mobility of the lips to permit selective grazing. They eat largely leaves, blossoms or seed and will tend to graze a lot of different kinds of weeds. In doing this they can control the weeds in a pasture.

Sheep - Cattle Interaction

While cattle will eat the tough, more mature plants, sheep will eat smaller, more immature plants. Sheep can graze certain toxic plants such as larkspur in moderate amounts, while cattle cannot. Sheep will usually graze higher areas of large, rolling pastures and not the wet low areas. Cattle will graze usually in wet lower areas. Where cattle and sheep are managed correctly, cattle will eat the taller grasses and therefore prevent "islands" of tall grass in the pasture. Since the grass is of uniform height it will be used better by both species. Finally sheep will graze closer to areas where cattle manure has accumulated than will cattle.

Type of Pasture Important

The best pasture type for companion grazing is where the fields are not all of the same elevation, that is with high and low places within the same pasture and having several types of plants. In these hilly areas, spraying of weeds may not be economical. Sheep and cattle would be very efficient in combination on this type of pasture.

Companion grazing usually works better where there is more than enough shade for cattle and sheep on the same pasture. Then usually the sheep and cattle will segregate and not try to crowd in the same shaded area.

Research indicates that companion grazing has no effect where the pastures are very high-quality, sprayed to control weeds and consists only of one or two types of grasses or legumes.

Advantages

Besides the obvious advantages of the different but complimentary grazing habits of cattle and sheep, there are other advantages to companion grazing. There are less worm problems because internal parasites that affect sheep will not affect cattle. If less cattle and less sheep are grazed than if either species was grazed by itself, there is usually less parasite problem. Also no clipping is usually required if the pastures are grazed by both species because there is more uniform grazing of the whole pasture.

Number of Sheep Per Cow

Most research has shown that between three and six sheep for each head of cattle will provide the greatest increase in total production of meat from a given acreage of pasture.

An important rule to remember in relation to this is there is no real advantage in adding cattle to sheep in a sheep operation—but there is a significant advantage of adding sheep to cattle for increased pasture production in a cattle operation.

Research Reports

Sixteen grazing seasons of research at the Sonora, Texas, Ranch Experiment Station showed that a combination of cattle, sheep and goats grazed together, or cattle and goats together, yielded larger gross returns per acre than each of the species grazed alone.

On humid pastures in Louisiana, the grazing of ewes and lambs with cows and calves increased carrying capacity and gain per acre over that of either species alone. This effect was attributed to the grazing by sheep of clover and broad-leaved weeds which the cattle did not consume. Similar results were seen in Washington where total gain/acre was greater when cattle and sheep were companion-grazed on irrigated orchardgrass-alfalfa pastures than when cattle were grazed alone.

In Ohio, yearling steers and ewe lambs were rotationally companion-grazed on birdsfoot trefoil-Kentucky bluegrass. Total gain per acre per season was greater at a 3:1 or 6:1 sheep-cattle ratio than for either species grazed separately (table 1). There was no benefit, however, at the 1:1 sheep-cattle

Table 1. Companion Grazing - Ohio Data
From A Three-year Study

<i>Sheep-Cattle Ratio</i>	<i>Avg. Gain (lbs/acre)</i>
Sheep Alone	286
Cattle Alone	268
1:1	268
3:1	285
6:1	291

ratio. Only in the case of the 6:1 ratio was the total average pasture gain greater than for sheep alone. All combinations of sheep with cattle produced greater gains than where cattle were grazed alone. The

carrying capacity was greater for sheep or sheep and cattle together than for cattle alone. This was a result of a greater utilization of the forage.

More Return Per Acre

It is easy to see that since companion grazing of sheep and cattle increases total gain per acre, then it will also return more profit per acre. The decision to add sheep to cattle in a cattle operation can be made only if a producer will be alert to new management practices that will make the program successful. It is essential that more progressive beef producers see companion grazing as the opportunity to increase farm pasture production.

ESSENTIALS OF GOOD CORRALS

Ron Parker

Efficient management of the beef cattle herd requires that the herd be confined several times each year for various purposes. Management practices such as vaccination, castration, identification, worming, implanting, dehorning and treating for lice, grubs and flies all require confinement of animals. No doubt many, if not all, of these practices do not get accomplished if adequate cattle handling facilities are not available.

Cattle handling facilities might be compared to new cars, in that they are made up of certain parts which are absolute essentials with a number of options which can be added. What is essential for one farm may be an optional accessory for another and will be determined by such things as the size and disposition of the herd and the labor supply situation.

Those items which would generally seem to be classified as essentials are a holding pen, working chute and headgate.

Holding pen—The holding pen should be large enough to accommodate the entire beef herd. A minimum of 20 square feet per animal is recommended for cow-calf operations.

Working chute—The length of the working chute will depend on the size of the cow herd, but 18 to 20 feet of chute will hold three mature cows and should be considered minimum. The working chute may be curved or straight. Totally enclosed sloping sides, overhead restrainers and a concrete floor are all excellent features. Cattle will move down a curved chute with enclosed sides because they cannot view what is ahead as they look for an escape route. Sloping sides reduce the area for the animal's feet and legs and lessen the capability of his turning around. Sloping sides also make it easier to work different size animals in the same chute. Overhead restrainers will prevent animals from rearing up and turning around. Overhead tie bars holding the sides of the chute together are essential to prevent spreading of the chute. In non-circular chutes without overhead restrainers these tie bars should be high enough to allow a person to walk down the chute without bumping his head.

The working chute should be 26 inches wide unless extremely large cattle are to be accommodated. In that case 28 inches may be required. One of the most annoying happenings when working cattle is for them to continually turn around in the chute. Probably the biggest single mistake made in corral building is to make the working chute too wide.

Headgate—A simple headgate can be constructed from heavy lumber or pipe, or many brands of commercial headgates are available. The three most common types of headgates used on a working chute or squeeze chute are the self-catching, stanchion and guillotine. Each of these types has advantages and disadvantages. The self-catching headgate is easy to operate, seldom chokes cattle if properly adjusted and works cattle fast without balking. However, the self-catching headgate is not well suited for horned cattle, requires a head table and nose bar to secure the animal's head, can cause severe shoulder bruises when cattle lunge at the cocked headgate and sometimes allows an animal to escape without being caught.

The stanchion headgate is also simple and fast to operate and seldom chokes cattle if properly adjusted. Disadvantages of the stanchion headgate are the need for a head table and nose bar, potential for shoulder bruises as cattle lunge toward the open stanchion, inability to prevent an animal from escaping without being caught from time to time and frequent tripping of cattle as they walk through the headgate.

The guillotine headgate holds the animal's head securely and lessens the potential of shoulder

bruises; but it is difficult to operate, can cause choking and is slower because cattle balk instead of moving forward freely.

A simple corral with these essentials will suffice for many Kentucky beef herds.

Optional features which may be added to a cattle working facility are additional holding pens, a sorting alley, crowding pen, squeeze chute, loading chute, scales and tipping calf table.

Additional holding pens—The addition of more holding pens will be dependent upon the size of herd and number of different classes of cattle normally kept. However, seldom will the beef herd be worked that it is not desirable to sort the herd into more than one group. Sorting of animals can best be done in an alley 12-14 feet wide with gates opening into adjacent pens.

Crowding pen—The crowding area is merely a specialized holding pen designed to funnel cattle into the working chute or loading chute. A well designed crowding area reduces the labor required to keep the working chute filled to essentially a one-man job.

Desirable characteristics for a crowding area are circular, totally enclosed sides, totally enclosed crowding gate and concrete floor. The crowding area should be totally enclosed so the only escape route visible to the animal is where you want him to go, through the working chute.

A quarter-circle crowding area with a 12 foot crowding gate is adequate for most operations, and will hold 7 or 8 mature cows. For larger operations half-circle or three-quarter-circle crowding areas may be justified.

Squeeze chute—A squeeze chute may be a desirable addition to many corrals. The squeeze chute allows for almost complete restraint of even the largest of animals and can be a tremendous asset for that purpose. However on small cow-calf operations a squeeze chute may not be economically justified and only a headgate may be used to hold the animal in position for working. Since a headgate only holds the animal's head, both the animal and cattleman are more susceptible to injury than with a squeeze chute.

Squeeze chutes can be purchased with a variety of features and types of construction. Important considerations are safety to both animal and operator, quietness, and type of controls on the headgate, squeeze and rear gate. Side opening and front opening models are available.

Loading chute—Some producers will consider the loading chute an essential part of their cattle handling system. Others with fewer animals may use trailers for movement of livestock without the use of a loading ramp. The main requirement of the loading chute is to be able to load a truck quickly and efficiently before the first cattle entering the truck decide to come back out. This means an adjacent holding pen must be sufficiently large to hold the largest number of cattle one would want to load at any one time.

Scales—A set of scales built into the working corral is probably a luxury only the largest producers can afford. However, valuable information can be obtained by the routine use of the livestock scale.

Calf table—A tipping calf table can greatly increase the efficiency and ease of handling calves weighing up to about 450 pounds. Although not an absolute essential in the list of facilities for handling cattle, a calf table can be a valuable tool when large numbers of calves need to be worked. The calf table can make jobs such as castrating, dehorning, branding and vaccinating, essentially one-man jobs, or allow up to three persons to perform different jobs simultaneously. Most models are reversible and allow the calf to be tipped with either the right or left side up.

Every cattle producer needs adequate cattle handling facilities. Each one must ask himself, "What is adequate for me?" Once this is decided, spend some time drawing alternative plans. Try to visualize all possible requirements for movement of cattle within the system and be certain gates swing in the

right directions. A few minutes time spent in planning a system will be rewarded by smooth efficient movement of cattle.

Listed below are suggested dimensions for beef cattle working facilities.

	<i>Size of Animals</i>		
	<i>Less than 600 lb.</i>	<i>600-1200 lb.</i>	<i>Over 1200 lb.*</i>
Holding Area	14	17	20 ft ² per animal
Working Chute with Vertical sides, width	18	22	26 inches
Working Chute with Sloping sides			
Width @ bottom	15	15	16 inches
Width @ top	20	24	26 inches
Working Chute Fence Height	45	50	50 inches
Corral Fence	60	60	60 inches

*Cow-Calf operations should utilize dimensions for over 1200 lb.

RESULTS OF EXTENSION DEMONSTRATIONS IN ANIMAL SCIENCE

John Johns, Curtis Absher, Russell BreDahl, Mason Morrison
and Ron Parker

Research findings at the University of Kentucky and other institutions indicate the effectiveness of different management procedures and identify new ones. It then becomes the role of extension to introduce these procedures to producers.

Research work at Kentucky and other institutions have shown that weaning weights of calves may be increased by the use of growth promoting implants and preweaning worming. Both result and method demonstrations were used by extension personnel during 1976 to better introduce these concepts to producers. Result and/or method demonstrations were conducted in Breathitt, Magoffin, Lawrence, Greenup, Johnson, Owen, Woodford, Grayson, Meade, Jefferson, Anderson, Livingston, Martin, Boyd, Washington, Graves, Hickman, Trigg, Daviess, Butler, Todd, Breckinridge and Carlisle counties.

Cattle, either suckling calves or grazing yearlings, were allotted to the demonstration groups by sex and weight. Results for suckling calves are shown in table 1. The 776 calves used in these demonstrations were implanted from day of birth up to about 3 months of age. On the average implanted calves out-performed nonimplanted calves. Implanted heifers had an increase in gain of 28 pounds and steers an increase of 27 pounds.

Table 1. Effects of Ralgro* on Gain of Suckling Calves

	<i>Imp Heifers</i>	<i>Nonimp Heifers</i>	<i>Imp Steers</i>	<i>Nonimp Steers</i>
No. of Calves	218	143	267	148
Initial wt., lb.	171	170	178	189
Final wt., lb.	395	366	418	402
Gain, lb.	224	196	240	213
ADG, lb.	1.60	1.52	1.66	1.58

*Ralgro is a brand name of zeranol and is used for reader convenience and understanding and does not constitute an endorsement by the University of Kentucky nor discrimination against similar products not named.

Grazing yearling cattle is a common beef enterprise in Kentucky. Growth stimulating implants work well with these cattle also (table 2). A total of 151 steers and heifers were used in these demonstrations. Implanted cattle again out-performed nonimplanted cattle. Implanted heifers had an increase in gain of 25 pounds and implanted steers an increase of 16 pounds.

Implanting with growth stimulants is but one facet of a complete management program. Other factors exist that will also help increase weaning weights. Research at the University of Kentucky has shown that worming suckling calves can result in increased weaning weights. This research finding was illustrated with result demonstrations during 1976.

Table 2. Effects of Ralgro* on Gain of Grazing Cattle

	<i>Imp Heifers</i>	<i>Nonimp Heifers</i>	<i>Imp Steers</i>	<i>Nonimp Steers</i>
No. of calves	19	14	70	48
Initial wt., lb.	302	291	467	432
Final wt., lb.	460	424	597	546
Gain, lb.	158	133	130	114
ADG, lb.	1.21	1.04	1.69	1.21

*Ralgro is a brand name of zeranol and is used for reader convenience and understanding and does not constitute an endorsement by the University of Kentucky nor discrimination against similar products not named.

Results of the various county demonstrations are given in the following tables.

Adjusted Weaning Weights (lb.) of Suckling Calves -
Owen County

	<i>Steers</i>	<i>Heifers</i>	<i>Overall</i>
Wormed	433.7	422.7	427.1
Nonwormed	417.8	428.9	424.8
Difference	15.9	- 6.2	2.3

Weights adjusted for age and initial weight

Adjusted Weaning Weights (lb.) of Suckling Calves -
Livingston County

	<i>Heifers (mean $\pm$ standard error)</i>
Wormed	396 $\pm$ 7
Nonwormed	378 $\pm$ 10

Weights adjusted for initial weight

Effect of Worming on Suckling Calves - Wayne County

	<i>Wormed</i>	<i>Nonwormed</i>
Initial wt., lb.	132	127
Final wt., lb.	278	267
Gain, lb.	146	140
ADG, lb.	1.6	1.57

Effect of Worming on Suckling Calves - Edmonson County

	<i>Wormed</i>	<i>Nonwormed</i>
Initial wt., lb.	371	369
Final wt., lb.	519	519
Gain, lb.	148	150
ADG, lb.	1.90	1.92

Effect of Worming on Suckling Calves - Graves County

	<i>Wormed</i>	<i>Nonwormed</i>
Initial wt., lb.	171	213
Final wt., lb.	311	364
Gain, lb.	140	151
ADG, lb.	1.67	1.80

Effect of Worming on Suckling Calves - Union County

	<i>Weight Gain</i>
Wormed, lb.	189.8
Nonwormed, lb.	198.6
Difference, lb.	- 8.8

Yearling Heifers Grazing Fescue-Clover Pasture - Owen County

<i>Weight gain from 22 April to 20 July, 1976 in pounds</i>			
	<i>Breed 1</i>	<i>Breed 2</i>	<i>Breed 3</i>
Wormed, lb.	123.6	111.5	116.3
Nonwormed, lb.	111.8	94.7	119.5

Breed 1 = Hereford Male x (Angus x Holstein) Female

Breed 2 = Angus Male x Holstein Female

Breed 3 = Angus Male x Holstein Female

Gain = adjusted for initial weight

Result demonstrations can be effective methods of introducing new or different concepts to producers.

SALE OF FEEDER CATTLE IN SELECTED KENTUCKY AUCTION MARKETS

Gary Shell, Everette Mackey and John Thomas Johns

Kentucky producers market between 900,000 and 1,000,000 feeder calves each year, representing the majority of income due to beef cattle in the state. Between 60,000 and 70,000 of these calves normally move through special grader feeder calf sales and the remainder sell in some other manner. Of this remainder, the majority are marketed through regular auction market sales. Detailed analysis have been done on special graded feeder calf sales, however, no description or analysis of regular auction market sales had been undertaken. Data did not exist to suggest that trends and composition of regular auction market sales were similar to those seen in special graded feeder calf sales. For these reasons a study was conducted in cooperation with the Kentucky Department of Agriculture, Division of Markets, Market News Reporting Service on selected Kentucky regular auction sales.

The period of time covered by the study was September 11 to November 30, 1976. A significant portion of Kentucky feeder calves move to market during this period of time. The selected markets were those normally covered by Market News Reporters and are listed in table 1.

Table 1. Location of Selected Regular Auction Sales

Bowling Green
Danville
Guthrie
Hopkinsville
Lancaster
Lexington - Bluegrass
Lexington - Clay Wachs
London
Marion
Paris
Richmond
Somerset
Winchester

Reporters collected data on weight, breed, sex, number in the pen, grade and sale price. Data was collected on 7,062 lots of cattle representing 30,114 head of steers and heifers. A summary of the data for steers and heifers is given in tables 2 and 3, respectively. Steers accounted for 66% of total cattle sold while heifers accounted for 34%. Steers sold in larger lots, at heavier weights and for more money per head and hundredweight than did heifers. The Angus breed comprised the greatest percentage of cattle sold in both sexes followed in order by Hereford, Black and White face, Charolais and other Crossbreds. No clear pattern could be established in average total dollars per head because average weight and price per hundredweight were too variable. Buyer preference, expressed as dollars per hundredweight, was consistent with one exception in both sexes. For steers, buyers preferred in order Black and White face, Angus, Hereford, Charolais and other Crossbreds. For heifers, buyers preferred in order Black and White face, Angus, Charolais, Hereford and other Crossbreds.

Table 2. Data Summary of Selected Regular Auction Sales for Steers

<i>Breed</i>	<i>Animals Sold</i>	<i>% of Total</i>	<i>Avg Lot</i>	<i>Avg Wt (lb.)</i>	<i>Avg \$/hd.</i>	<i>Avg \$/Cwt.</i>
Angus	7954	40	6.3	592	199.81	33.76
Hereford	5187	26	3.9	588	192.42	32.70
Charolais	2536	13	3.8	595	193.83	32.57
B&W Face	3316	16	4.6	556	193.40	34.75
Other Crossbred	975	5	2.7	640	192.19	30.04
Holstein	23	.1	2.9	763	194.90	25.54
Total & Avg	19991	100	4.6	588	195.69	33.28

Table 3. Data Summary of Selected Regular Auction Sales for Heifers

<i>Breed</i>	<i>Animals Sold</i>	<i>% of Total</i>	<i>Avg Lot</i>	<i>Avg Wt (lb.)</i>	<i>Avg \$/hd.</i>	<i>Avg \$/Cwt.</i>
Angus	3191	31.5	4.3	488	126.57	25.93
Hereford	2805	27.5	3.3	508	128.35	25.24
Charolais	1579	15.5	3.6	509	132.03	25.92
B&W Face	2092	20.5	4.4	480	128.62	26.80
Other Crossbred	456	5.0	2.1	504	113.79	22.56
Total & Avg	10123	100	3.7	496	127.77	25.75

Grade by breed data for steers and heifers is presented in tables 4 and 5, respectively. Black and White face, Angus and Hereford steers graded as well as or above the average of all steers. Charolais and other crossbreds graded below the average of all steers. Heifers did not show the same trend as Black and White face, Charolais and Angus graded equal to or above the average for all heifers. Herefords and other crossbreds graded below the average for all heifers.

Table 4. Summary of Grades by Breed of Steers at Selected Regular Auction Sales

<i>Breed</i>	<i>Percent Grading U.S.D.A.</i>			
	<i>Choice</i>	<i>Good & Choice</i>	<i>Good</i>	<i>Standard</i>
Angus	75	8	16	1
Hereford	66	11	20	3
Charolais	57	10	31	2
B&W Face	80	9	10	1
Other Crossbreds	38	10	32	20
All Breeds	69	9	19	3

Table 5. Summary of Grades by Breed of Heifers at Selected Regular Auction Sales

<i>Breed</i>	<i>Percent Grading U.S.D.A.</i>			
	<i>Choice</i>	<i>Good & Choice</i>	<i>Good</i>	<i>Standard</i>
Angus	60	14	22	4
Hereford	55	15	26	4
Charolais	67	7	22	4
B&W Face	74	13	12	1
Other Crossbreds	33	2	23	42
All Breeds	61	12	21	6

A regression analysis was conducted to determine the effect of average weight and pen size on sale price of steers and heifers. The following regression equation expresses the relationships between price per hundredweight (Y) and calf weight (X) in steers: $Y = 3027.49 + 0.55X + (-0.00084) X^2$. The relationship is expressed graphically in figure 1. In general, lightweight feeder steers brought more per hundredweight than heavier feeder steers. Maximum price for steers was obtained at a weight of 344 pounds and declined thereafter as weight increased. Buyers apparently felt they could produce weight more cheaply than it could be purchased.

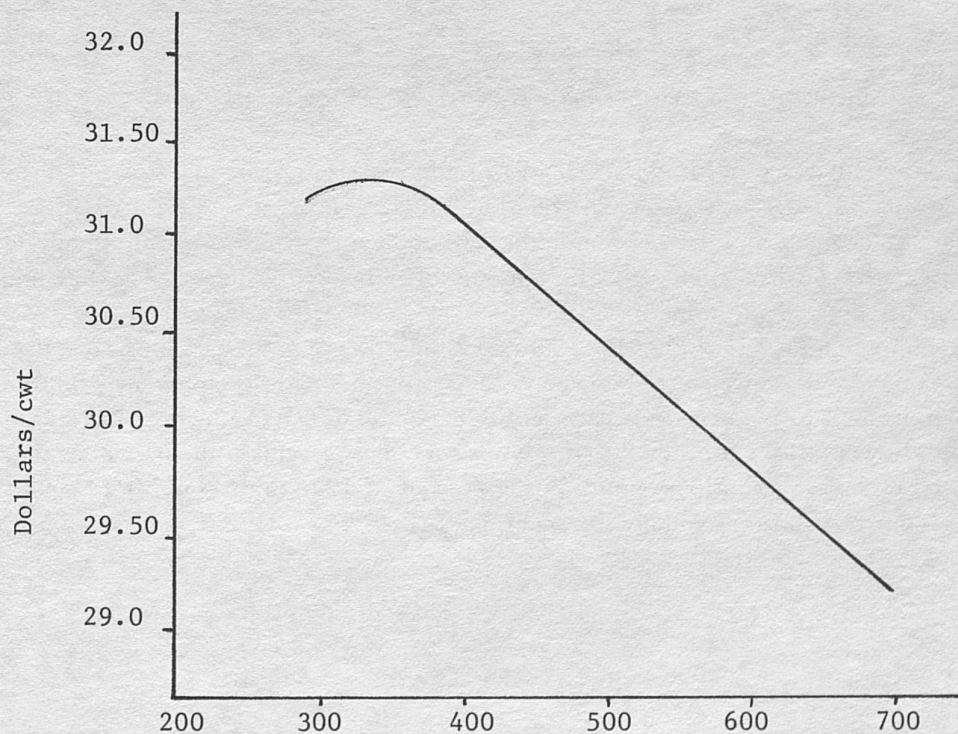


FIGURE 1. RELATIONSHIP OF WEIGHT AND PRICE IN STEERS

The following regression equation expresses the relationship between price per hundredweight (Y) and calf weight (X) in heifers: $Y = 2004.51 + 1.44X + (-0.0011)X^2$. This relationship is expressed graphically in figure 2. The response of price to weight was not the same in heifers as in steers. Price per hundredweight increased with weight increases until a maximum price was reached at 654 pounds. Factors other than cost of weight gain apparently were influencing heifer price-weight relationships.

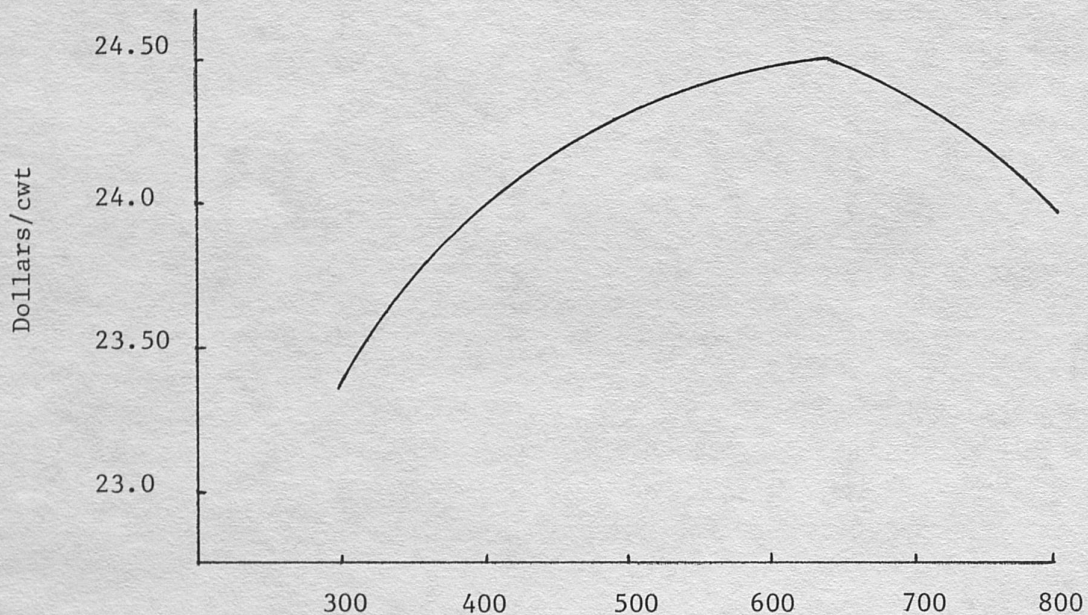


FIGURE 2. RELATIONSHIP OF WEIGHT AND PRICE IN HEIFERS

The relationship of price per hundredweight (Y) and pen size (X) in steers is described by $Y = 3027.49 + 35.56X + (-1.15)X^2 + 0.0X^3$. The relationship is cubic (figure 3) with the first optimum number of steers at 21 per pen. Price per hundredweight apparently decreases from 21 to 55 head per pen and increases after 55 head per pen. The amount of data on the larger pens was limited and therefore the validity may be questioned.

The regression equation $Y = 2004.51 + 22.80X + (-0.646)X^2 + 0.0078X^3$ illustrates the relationship between price per hundredweight (Y) and pen size (X) for heifers. Price apparently did not reach a maximum but continued to increase with each additional heifer added (figure 4). The rate of increase was not constant, however, as it continued to decrease as number of head in the pen increased.

This data represents relationships found during the fall of 1976 and should not be construed to mean that these same relationships will always occur.

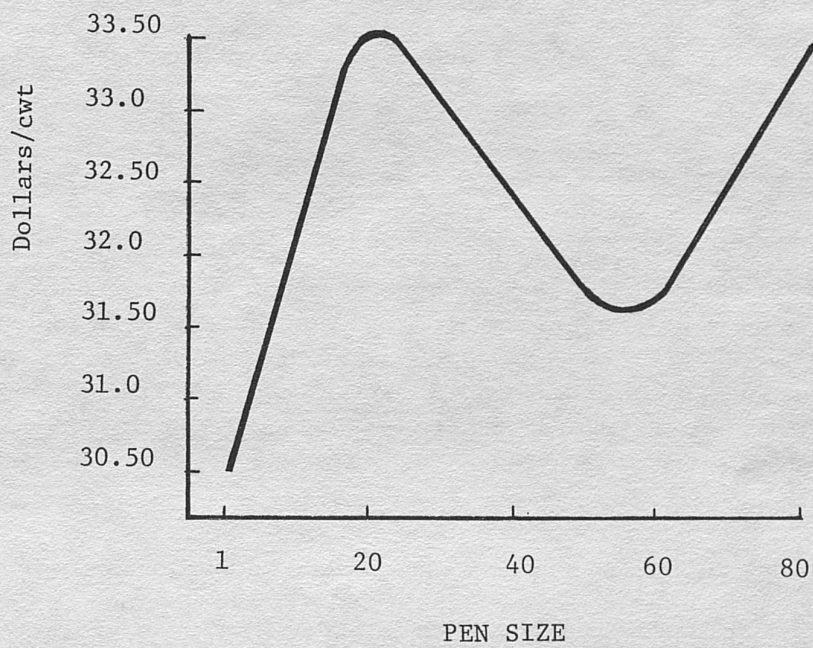


FIGURE 3. RELATIONSHIP OF PRICE AND PEN SIZE IN STEERS

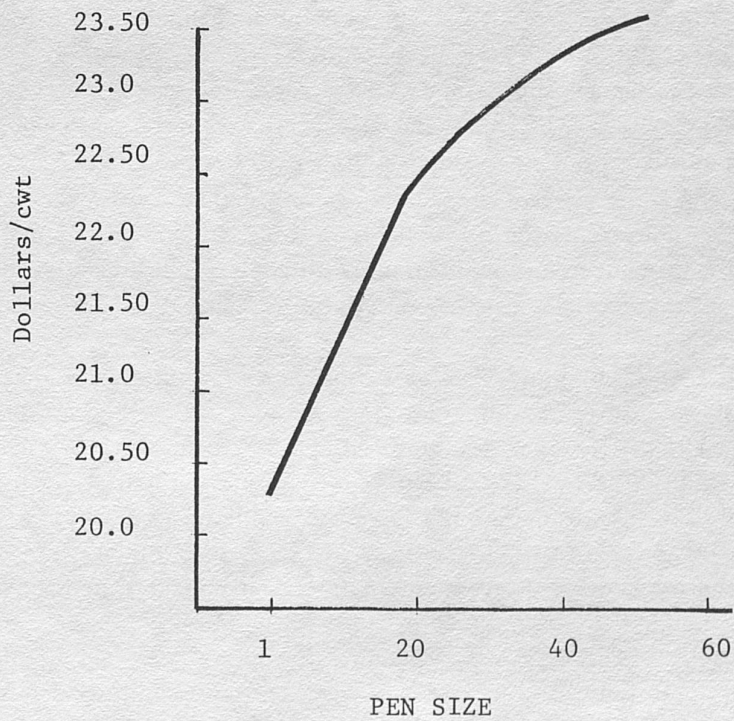


FIGURE 4. RELATIONSHIP OF PRICE AND PEN SIZE IN HEIFERS

FEEDER CALF SALES REPORT - FALL 1976 - SPRING 1977

Everette Mackey

Just over 78,095 feeder cattle were marketed through special feeder sales during Fall 1976 and Spring 1977. Spring sales totaled 19,261, the largest number ever recorded in graded spring sales in Kentucky. Average number per sale was also up to 1,237 head per sale which was 300 head per sale over the 931 head per sale in 1976 and some 450 head per sale over the 775 average posted in 1975. Size of sale lot, "a significant factor in price," was also up from the 7.6 head per lot in 1975 and up from the 9.2 head per lot in 1976 to an all time high for spring sales of 10.7 head per sale lot in 1977.

Appropriate interpretation of records can be an important factor in planning for better marketing. Obvious factors that affect overall price are: (1) The *total number* at a sale influences toward a strong market. More farmers are attracted to larger sales thus increasing the potential buyers for all cattle but especially for small calves that generally are in small lots. Order buyers can consistently get a load or two of calves at the larger sales and will therefore have representatives present when the sale starts. Feeder buyers who buy their own cattle are more willing to take time to travel to a large sale where their chances are good of getting a 42,000 lb. load of reasonably uniform calves. All these add up to a good contingent of competitive buyers which results in a strong market. (2) *Average size of sale lot* affects price in that most buyers are willing to pay more for larger lots of uniform calves. A buyer spends less time filling his needs from larger lots and when he bids he has less risk of having an incomplete order at the end of the sale. Consequently, he is willing to *bid more actively on larger lots*. Whatever causes a calf to sell in a small sale lot, whether it be the market location, the breed, the grade, the weight, or the time, will result in a discount in price for that calf. (3) *Quality and weight* affect price. Quality price differences have been about \$1 to \$2 extra for grade C-1 calves over C-2 calves and C-2 grade calves average approximately \$3 per hundred over G-3 calves. This trend has been consistent for several years. Price difference due to weight was more nearly "normal" for 1976 and 1977 sales, in that small steers brought the highest price per cwt. and as steers got larger the price paid was reduced. Conversely, some larger, fatter heifers were in demand for slaughter and sold as high or higher than small feeder heifers. (4) *Uniform known breed characteristics* commanded a stronger price than those difficult to distinguish and/or of unknown breeding. The Black-White- face calf generally brought to the highest price per cwt. with Angus, Hereford, Charolais and other crosses in that order with respect to price.

The above should be used by farmers in improving their production and marketing efforts.

The following tables illustrate the foregoing statements.

Illustration 1 deals with lot size. An important point of this table is that over 75% of these 58,000 calves sold in Fall 1976 sales were in lots of 10 or more. Such a feat indicates many people worked long and hard to make this marketing program available to farmers.

The graph (illustration 2) showing C-1, C-2, and G-3 steers and heifers by grade and weight represent the significance of grade to price. The heifer graph indicates areas of problems and opportunities in marketing heifer calves. The large price difference between heifers and steers probably is due to the fact that buyers believe that some heifers are pregnant, as well as other health considerations. These problems are difficult to attack individually and require industry commitment.

Price difference due to breed is illustrated in the third illustration. Breed is confounded with pen size to some extent in that the higher priced breeds were also more available in larger lots. This clearly illustrates that an important consideration of the average calf producer is that of selecting a breeding program that will produce calves that will "fit well" with neighbors calves.

Illustration One

1976 - 53 Fall Sale Summary by Size of Sale Lot

<i>Lot Size</i>	<i>Average</i>	<i>No. of Lots</i>	<i>Percent of Lots</i>	<i>No. of Head</i>	<i>Percent of Head</i>	<i>Average Price</i>
Singles	1.0	1,238	21	1,238	2	28.09
2 - 5 head	3.2	1,959	33	6,187	11	29.75
6 - 9 head	7.4	876	15	6,489	11	30.55
10 - 19 head	13.5	993	17	13,455	23	31.63
20 - 29 head	23.9	347	6	8,277	14	32.95
30 - 49 head	36.8	276	5	10,167	18	34.34
50 + head	<u>74.3</u>	<u>165</u>	3	<u>12,263</u>	21	<u>35.35</u>
Total & Average	9.9	5,855		58,083		32.75

*Graded Calves Only

Note: The \$7.26 per cwt. price differential for calves sold as singles versus calves sold in lots of 50 or more head is one of the largest such spreads since special graded and grouped feeder calf sales were started in Kentucky. These are weighted averages disregarding grade, size, breed, sex or location. Whatever causes calves to sell in small lots costs the farmer or deprives him of income he could have had if his calves had sold with large groups.

The two tables in illustration 4 summarize all graded calves in the fall sales of 1976 and the spring sales of 1977. This is presented for study and consideration as plans are made for improved marketing.

Illustration Four

Kentucky Feeder Calf Sale

** 53 * Fall Sales * Aug thru Dec * 1976 **

<i>Breed</i>	<i>No. Head</i>	<i>Avg Lot</i>	<i>Avg Wt (lb.)</i>	<i>Average Price</i>	
				<i>(\$/head)</i>	<i>(\$/Cwt.)</i>
<i>Steers</i>					
Angus	14,486	17.5	563	205.94	36.56
Hereford	6,350	9.0	580	202.54	34.89
Charolais	4,340	7.5	613	205.50	33.51
B&W Face	7,373	11.6	579	215.87	37.30
Crossbred	3,700	7.0	598	187.70	31.38
Holstein	0				
Total & Avg	36,249	11.1	579	205.45	35.49
<i>Heifers</i>					
Angus	8,800	13.0	488	136.89	28.03
Hereford	3,150	6.2	498	133.72	26.86
Charolais	2,918	6.3	536	141.97	26.48
B&W Face	4,816	9.4	501	145.57	29.05
Crossbred	2,150	5.1	516	126.92	24.58
Holstein	0				
Total & Avg	21,834	8.5	502	138.04	27.52
Grand Total	58,083	9.9	550	180.11	32.75

** 16 * Spring Sales * March and April 1977 **

<i>Breed</i>	<i>No. Head</i>	<i>Avg Lot</i>	<i>Avg Wt (lb.)</i>	<i>Average Price</i>	
				<i>(\$/head)</i>	<i>(\$/Cwt.)</i>
<i>Steers</i>					
Angus	5,055	19.1	570	229.58	40.27
Hereford	2,267	11.1	573	227.72	39.73
Charolais	1,412	8.2	601	231.21	38.48
B&W Face	2,199	11.5	576	238.98	41.46
Crossbred	1,367	6.4	612	228.40	37.34
Holstein	0				
Total & Avg	12,300	11.7	580	230.97	39.83

		<i>Heifers</i>			
Angus	2,801	13.7	491	161.94	32.96
Hereford	1,067	7.4	501	163.98	32.74
Charolais	973	8.0	553	179.85	32.51
B&W Face	1,458	10.1	499	168.99	33.87
Crossbred	662	5.1	505	156.13	30.90
Holstein	0				
	-----	-----	-----	-----	-----
Total & Avg	6,961	9.3	504	165.68	32.85
	-----	-----	-----	-----	-----
Grand Total	19,261	10.7	553	207.38	37.52
	-----	-----	-----	-----	-----

For additional information, contact E. Mackey or J. Gamble, Extension marketing specialists. Phone (606) 257-1871.

PREVENTIVE MEDICINE CALENDAR FOR SPRING CALVING BEEF COWS

Duane Miksch

Calving is a natural focal point of the cow-calf annual cycle. Dates can be adjusted accordingly for a calving season other than March-April. For a preventive medicine program to be practical and effective, calving should be limited to no more than 65 days.

FEBRUARY 10

Begin Calving Heifers

This will allow 3 weeks of close attention before cows begin to calve.

Heifers calved early will have extra time needed to breed back.

Refer to ASC-46, *Coping With Calving Difficulty* for calving information.

MARCH - APRIL

Calve Cows

Refer to ASC-46, *Coping With Calving Difficulty*.

Identify calves as they are born. (Refer to ASC-11)

Vaccinate calves against blackleg - malignant edema soon after birth.

Castrate and Dehorn from birth to 4 months.

Refer to ASC-55, *Castration and Dehorning*.

Have Herd Bulls Evaluated for Breeding Soundness

This is much more than a fertility check.

Physical condition and genital system function are equally important.

APRIL - OCTOBER

Control Flies Constantly (ENT-4 and 11 are applicable).

Use sprayers, foggers, oilers, dusters, pour-on and/or feed through larvacides. (Follow label directions exactly.)

Minimize Pinkeye

Clip pastures.

Provide shade on high ground.

Control flies.

Treat eyes of all cattle as soon as infection appears in the herd.

Put patches on badly infected eyes. (Refer to ASC-51.)

MAY 1 - JUNE 15

Breed Heifers for 45 days beginning 3 weeks ahead of cows.

MAY 20 - JULY 20

Breed Cows.

AUGUST

Examine Bred Heifers for Pregnancy

Estimate calving date by early examination.

Cull open heifers to conserve pasture.

Sell surplus pregnant heifers as replacements.

Treat for Grubs and Lice

Work Calves (minimum of 3 weeks prior to weaning).

Castrate and dehorn if not already done.

Worm. (See VET-2).

Implant with growth stimulant. (See ASC-15 and 25).

Re-vaccinate against blackleg-malignant edema.

Vaccinate against leptospirosis.

Vaccinate against IBR-PI₃ (use intranasal vaccine because intramuscular vaccine might be shed to pregnant cows and cause abortion).

Vaccinate against BVD.

NOVEMBER

Start calves on palatable high energy ration 3 weeks before weaning.

DECEMBER

Wean Calves

Remove cows from sight and hearing of calves.

Re-worm Calves.

Examine Cows for Pregnancy.

Cull cows if open; old; bad udders, eyes, feet; other defects

Vaccinate Cows against Leptospirosis (pomona and hardjo), Vibriosis, and clostridial infections.

Worm cows and herd bulls.

JANUARY

Vaccinate weanlings against IBR-BVD-PI₃ with Intramuscular Modified Live Virus Vaccine.

At 8 or 9 months they are old enough to develop a solid lasting immunity.

Being weaned, they will not expose pregnant cows to vaccine virus.

They will have recovered from weaning stress.

Treat all cattle for lice.

FEBRUARY

Re-treat for lice in 21 days if lice were evident at time of January treatment.

Vaccinate Replacement Heifers and Herd Bulls for Leptospirosis (pomona and hardjo) and Vibriosis.

FEBRUARY - APRIL

Feed Supplemental Magnesium to Cows to prevent Grass Tetany (Refer to ASC 16, *Grass Tetany in Beef Cattle*)

SUMMARY OF PERFORMANCE TESTED BULL SALES IN 1977

Russell BreDahl

Two performance tested bull sales sponsored by the Kentucky Beef Cattle Association, with the University of Kentucky cooperating, were held in the spring of 1977. One was held at Princeton in March, the other at Paris in April.

The Princeton sale features bulls that have completed a 365-day adjusted weight record on the individual breeder's farm using testing procedures specified in the University of Kentucky's Beef Herd Improvement Program. Although a few yearling bulls are sold at Princeton, most of the bulls are 2 years old or older.

The bulls sold at Paris were graduates of the 1976-1977 Kentucky Central Bull Test, which was conducted at the Eden Shale Farm near Owenton starting in October 1976 and ending in March 1977. Individual breeders consigned bulls born between January 10 and March 31 of 1976 for testing. All of the bulls at the test eat the same feed mix, are housed in the same building and are lotted in the same pen so that environmental influences on test gains are minimized.

Because environmental conditions are standardized for all bulls at the central test, it is possible to make valid comparisons of on-test performance of bulls from different herds. Such comparisons, however, are invalid with the records available on the bulls sold at Princeton. The average age on sale day of the bulls sold at Paris was 13.5 months.

Summaries of the two sales follow.

On Farm Performance Tested Bull Sale
Princeton, Kentucky
March 18, 1977

<u>Breed</u>	<u>No.</u>	<u>205 Day</u> <u>Adj. Wt.</u>	<u>ADG</u>	<u>365 Day</u> <u>Adj. Wt.</u>	<u>WPA</u>	<u>Price</u>
Angus	23	553	3.45	1104	2.91	1201.09
Hereford	11	564	2.74	1001	2.73	480.91
P. Hereford	70	561	3.06	1050	2.83	733.64
Simmental	6	615	3.17	1121	2.89	658.33
All Breeds	110	562	3.11	1060	2.84	802.00

Central Bull Test Station Sale
Paris, Kentucky
April 11, 1977

<u>Breed</u>	<u>No.</u>	<u>205 Day</u> <u>Adj. Wt.</u>	<u>ADG</u>	<u>365 Day</u> <u>Adj. Wt.</u>	<u>WPA</u>	<u>Price</u>
Angus	11	554	2.92	1025	2.71	785.91
Charolais	9	658	3.42	1201	3.16	714.44
P. Hereford	24	561	2.86	1022	2.71	571.71
Red Poll	2	558	2.63	952	2.51	400.00
Simmental	5	650	3.72	1220	3.15	600.00
All Breeds	51	585	3.04	1071	2.82	639.61

Similar sales are planned for 1978. Further information about performance testing programs in Kentucky can be obtained from your county extension agent for agriculture.

GROWTH OF STEERS FED SOYBEAN MEAL OR UREA SUPPLEMENTED WITH DIFFERENT LEVELS OF SULFUR

G. M. Hill, N. W. Bradley and J. A. Boling

Supplementation of corn silage with preformed sources of protein (such as soybean meal) in other studies resulted in improved gain and feed efficiency as compared with steers fed unsupplemented corn silage. The substitution of isonitrogenous urea supplements for soybean meal in corn silage diets fed to growing steer calves resulted in decreased gains. Several workers have suggested that addition of sulfur to urea supplements for lightweight calves fed corn silage diets may result in improved performance. This study was designed to further evaluate the performance of lightweight steer calves fed corn silage plus soybean meal or urea as nitrogen sources, with each nitrogen source containing 0, .15 or .30% added sulfur.

One hundred and twenty Angus x Hereford crossbred steers were assigned to 12 pens in a 140-day experiment. They were fed corn silage plus one of the supplements presented in table 1. The supplements were calculated to be isonitrogenous and contained either soybean or urea as nitrogen sources. Within each nitrogen source, elemental sulfur was added to the diets at levels calculated to equal 0.0, 0.15 or 0.30% of the total dietary dry matter. Each steer was fed 0.91 kg of the respective supplement daily plus corn silage *ad libitum*. The corn silage fed analyzed 37.0% dry matter and 6.48% crude protein on a dry-matter basis.

Table 1. Composition of Experimental Supplements Containing Different Nitrogen Sources and Added Sulfur

Nitrogen Source Added S level, %	Soybean Meal			Urea		
	0.00	0.15	0.30	0.00	0.15	0.30
Ingredients, %						
Corn	35.52	34.65	33.65	78.15	77.30	76.31
Soybean meal, 44%	50.00	50.00	50.00	-----	-----	-----
Urea 281	-----	-----	-----	6.48	6.48	6.48
Molasses	10.00	10.00	10.00	10.00	10.00	10.00
Limestone	1.80	1.79	1.79	1.71	1.66	1.67
Dicalcium phosphate	.96	.98	.99	2.05	2.07	2.09
Trace Mineral Salt	1.62	1.62	1.62	1.62	1.62	1.62
Sulfur	-----	.97	1.95	-----	.98	1.95
Analyses ^a						
Crude protein equivalent (NX6.25), %	19.42	19.23	19.12	18.66	19.15	19.23
Sulfur, %	.29	1.14	1.65	.24	.81	1.72
N:S Ratio	11.23:1	2.71:1	1.85:1	11.45:1	3.88:1	1.79:1

^aAnalyses reported on a dry-matter basis

Average daily gains of steers throughout the 140-day trial are presented in table 2. Steers fed the soybean meal supplements had higher daily gains than those supplemented with urea. Sulfur supplementation did not improve gains among the groups of steers fed soybean meal. However, sulfur supplementation resulted in improved gains in steers fed the corn silage diets supplemented with urea. There was no difference in gain between the steers fed urea plus 0.15% or 0.30% added sulfur.

Table 2. Performance of Steers Supplemented with Nitrogen and Sulfur

Nitrogen source Added S level, %	Soybean Meal			Urea		
	0.00	0.15	0.30	0.00	0.15	0.30
No. steers	20	20	20	20	20	20
Initial weight, kg ^a	202.0	202.9	200.4	189.2	192.2	191.9
Final weight, kg ^a	305.0	304.4	299.4	265.8	279.6	280.8
Avg. daily gain, kg ^{bc}	.74	.73	.71	.55	.63	.64

^aWeights taken after 24-hour feed restriction.

^bNitrogen sources differ significantly ($P < .05$).

^cUrea with sulfur higher ($P < .10$) than urea without added sulfur.

Feed intake and efficiency values are presented in table 3. Urea supplemented steers consumed less silage than those supplemented with soybean meal. Feed efficiency was improved in steers supplemented with soybean meal as compared to those fed the urea supplements. Sulfur supplementation had no effect on feed efficiency of steers fed the SBM supplements, but feed efficiency was improved in the urea supplemented groups by sulfur supplementation. The steers fed urea supplements containing 0.15 or 0.30% sulfur had rather similar feed efficiency values. These data suggest that the addition of sulfur to all-urea supplements fed with corn silage to growing steers results in improved gain and feed utilization.

Table 3. Average Daily Feed Intake and Conversion Based on 140 Day Trial

Nitrogen Source Added S level, %	Soybean Meal			Urea		
	0.00	0.15	0.30	0.00	0.15	0.30
No. steers	20	20	20	20	20	20
Corn silage intake, kg ^a	12.35	12.39	12.11	10.43	11.40	11.44
Corn silage intake, (DM), kg ^b	4.57	4.58	4.48	4.08	4.22	4.23
Total feed intake, kg ^{ad}	13.26	13.30	13.02	11.34	12.31	12.35
Total feed intake, (DM), kg ^c	5.42	5.37	5.32	4.70	5.07	5.08
Feed/gain (DM) ^a	7.36	7.42	7.54	8.82	8.13	8.00

^{abc}Nitrogen sources differ significantly: a = ($P < .06$); b = ($P < .05$); and c = ($P < .07$).

^dTotal feed intake consists of free choice corn silage and 0.91 kg of the respective supplement (table 1.)

WINTERING STEER CALVES

Nelson Gay and J. A. Boling

Since many cattlemen continue ownership of home raised calves or purchase calves for growing-wintering programs, it seemed appropriate to study the influence of Rumensin under these conditions. At times, in such programs, neither protein nor grain is fed, even though this results in expensive, inefficient gains. When cattle are consuming hay or forage only, the use of feed additives is hindered. However if the additive can be administered in the salt-mineral mix or in a protein block, it may be feasible. In this instance it was decided to combine Rumensin with a salt-mineral-vitamin mixture for free choice feeding. Presently FDA does not approve the use of Rumensin in such combinations. This study was conducted in part to obtain data necessary for such approval. Also, observations were made on the effects of SBOM, sulfur supplementation and shelter on performance of growing steer calves.

Angus, Hereford, Ang x Her and mixed-bred calves were assigned to five treatment groups based on weight and breeding. Twelve lots of 10 steers each were fed inside and one group of 23 head was fed outside without shelter. Routine vaccinations, worming, grub and louse treatments were administered. All calves were implanted with 30 mg. DES per head at the initiation of the trial. Treatment groups were: (A) control-fed large, round bales of fescue-clover and the mineral mixture without Rumensin, free choice; (B) same as A except Rumensin was added to the mineral mix at the rate of 800 mg. per pound; (C) same as A except calves were hand fed 1.5 lbs. 44% soybean meal per head per day; (D) same as C except sulfur was added to the soybean meal to furnish 7.8 grams sulfur per head daily; (E) same as C except calves were fed in an outside lot without shelter.

Results of this 107 day study are presented in table 1. Calves consumed large round bales in confinement with a minimum of waste. The use of feeding racks essentially eliminated hay wastage. The .75 pounds per day gain on hay plus mineral is about as expected. Although consumption of

Table 1. Effects of Rumensin, Soybean Meal, Sulfur and Shelter on Wintering Steer Calves

	<i>Control</i>	<i>Rumensin</i>	<i>SBOM</i>	<i>SBOM+ Sulfur</i>	<i>Outside +SBOM</i>
No. calves	30	30	30	30	30
No. Days	107	107	107	107	105
Avg. start wt., lb.	469	464	464	465	464
Avg. end wt., lb.	534	557	576	578	570
ADG, lb.	.75	.99	1.11	1.14	1.03
Feed:Gain	19.9	16.2	14.9	13.5	16.8
<u>Avg. Daily Ration</u>					
Hay, lb.	14.9	16.0	15.0	13.9	15.8
SBOM, lb.	-----	-----	1.5	1.5	1.5
Min. Mix, gms.	86	41	86	86	80

Rumensin was approximately 75 mg daily, an improvement in gain and feed utilization was realized (32 and 18.6%, respectively). The addition of SBOM also improved gain and feed efficiency (48 and 25.1%, respectively). Whether this effect was due to energy or protein is difficult to say. Although the addition of sulfur did not influence gains a slight improvement in feed efficiency was noted (9.4%).

Severe weather conditions (cold) was experienced during the study. However, performance of calves fed outside was reduced less than 10%. They did require 11% more feed per unit of gain than their counterparts fed inside.

RESPONSE OF STEERS FED DIFFERENT PROTEIN LEVELS AND CORN SILAGE

L. C. Pendlum, J. A. Boling and N. W. Bradley

The production of corn silage has increased tremendously in the past few years and offers a great potential for utilization in cattle growing systems. Although silage is an excellent source of energy, maximum performance is achieved from silage only when supplemented with protein. This 112-day experiment was conducted to study the effect of different levels of soybean meal (SBM) on the performance of growing steers, when offered as a protein supplement to corn silage diets.

One-hundred-twenty Angus steer calves averaging 214.2 kg in body weight were randomly allotted to 4 treatment groups with each group replicated three times in lots containing 10 steers each. Group A (the negative control group) was offered an *ad libitum* diet of corn silage which contained 38.4% dry matter and 7.58% crude protein (DM basis). Groups B, C and D were fed equal quantities of corn silage plus .45, .68, or .91 kg of SBM per head daily, respectively. In addition, all steers were offered free choice a steamed bone meal and trace mineral salt mixture containing 1410 IU of vitamin A per gram.

Growth, feed intake and feed efficiency as affected by the level of supplemental SBM is presented in table 1. Daily gain for steers in treatment groups A, B, C and D was .19, .75, .77 and .84 kg, respectively, with all groups of supplemented steers gaining faster ($P < .01$) than steers fed no supplemental protein. Dry matter intake and feed efficiency was 3.56, 18.74; 5.03, 6.71; 5.22, 6.78 and 5.42, 6.45 for treatment groups A through D, respectively. These means represent an increased ($P < .01$) dry matter intake and a lower ($P < .01$) feed per gain ratio for the SBM supplemented steers. Although steers supplemented with .68 or .91 kg of SBM had non-significant ($P > .05$) overall increases in ADG and similar feed efficiencies when compared with steers fed .45 kg of SBM daily, period gains suggested that the two higher levels of protein supplementation resulted in greater initial gain responses. This early increase in body weight tended to be maintained throughout the trial, particularly with steers in group D which were offered the highest level of SBM.

Table 1. Feed Intake, Gain and Feed Efficiency of Steers Fed Different Levels of Soybean Meal (112 Days)

	<i>Treatment</i>			
	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>
No. steers	30	30	30	30
Initial wt, kg	212.5	215.6	214.2	217.1
Final wt, kg	283.5	299.9	300.5	311.0
Avg. daily gain, kg	.19	.75	.77	.84
Daily ration, kg ^a	3.56	5.03	5.22	5.42
Silage	3.56	4.63	4.61	4.61
SBM	.00	.40	.61	.81
F/G ^a	18.74	6.71	6.78	6.45

^aCalculated on a dry-matter basis.

NONCONTINUOUS PROTEIN LEVELS FOR GROWING CALVES

L. C. Pendlum, J. A. Boling and N. W. Bradley

Calves that enter the feedlot as lightweight feeders to be utilized in growing-finishing systems may be subjected to tremendous amounts of stress to include such processes as weaning, movement through stockyards, shipping, worming, vaccination, adjustment to a strange environment, etc. These stresses undoubtedly result in the protein status of these calves being in a rather depleted state. Therefore, it seemed feasible that early feeding of protein at levels higher than current listed requirements could be of benefit to the improvement of the protein status of such calves, resulting in improved feedlot performance.

Forty-eight Hereford bull calves averaging 178.0 kg at weaning were randomly allotted to 3 treatment groups. From days 1-37, calves in groups A, B and C were fed .45, .90 or 1.36 kg of soybean meal (SBM) per head daily, respectively. Treatment groups were twice replicated in pens containing 8 calves each. To maintain supplemental energy intake among groups similar, calves in treatment groups A and B were also fed .90 and .45 kg of ground shelled corn per head daily, respectively. In addition, all calves were fed equal quantities of corn silage which analyzed 38.4% dry matter (DM) and 7.40% crude protein on a dry-matter basis. A mixture of steamed bone meal and trace mineral salt was offered free choice. From days 38-107 of the trial, all calves were fed .45 kg of SBM and .90 kg of ground shelled corn per head daily plus corn silage.

The results of this study are presented in table 1. Average daily gain in period 1 was lower ($P < .05$) and feed per unit of gain higher ($P < .05$) for calves fed .45 kg of SBM than for those fed diets supplemented with either .91 or 1.36 kg of SBM per head daily. Average daily gain and feed per gain were similar among all treatment groups during period 2. Small increases in gain were observed among treatments A, B and C when periods 1 and 2 were combined. This overall response in gain was due, however, to the gains of these respective groups during period 1, reflective of the additional protein fed during this period.

Table 1. Growth and Efficiency of Calves Fed Different Levels of Supplemental Protein During Days 1-107 of Trial

	<i>Treatment</i>		
	<i>A</i>	<i>B</i>	<i>C</i>
No. animals	16	16	16
Initial wt, kg	179.0	183.5	183.8
Final wt, kg	269.0	279.0	280.8
First period (days 1-37) ^a			
ADG, kg	0.99 ^c	1.25 ^d	1.30 ^d
DM intake/day, kg	4.59	4.86	5.00
F/G	4.64 ^c	3.89 ^d	3.85 ^d
Second period (days 38-107) ^b			
ADG, kg	0.80	0.77	0.79
DM intake/day, kg	5.31	5.34	5.34
F/G	6.64	6.94	6.76
Overall (107 days)			
ADG, kg	0.87	0.94	0.97
DM intake/day, kg	5.07	6.18	5.17
F/G	5.82	5.51	5.33

^aAnimals fed diets A, B and C received .45, .90 and 1.36 kg SBM per head daily, respectively, during days 1-37 of trial.

^bAnimals fed diets A, B and C received .45 kg SBM per head daily during days 38-107 of trial.

^{c,d}Means on the same line bearing different superscripts differ significantly ($P < .05$).

FAT TREATMENT OF PROTEIN FOR STEERS

B. P. Glenn and D. G. Ely

A new technique has been developed at the University of Kentucky to improve protein utilization for steers in the feedlot. The protein supplement, linseed meal, was coated with tallow at the rate of .3 pound of fat/pound of supplement. Previous studies in the laboratory with sheep have shown that treating the proteins with fat improved nitrogen digestibilities and increased nitrogen retention. Also reduced ruminal ammonia levels were observed with fat indicating that the fat coating may be protecting the protein from breakdown in the rumen. The next step was to determine how the ruminant animal would perform in the feedlot when consuming the fat-coated proteins.

A feedlot trial was conducted with crossbred steers. In addition to tallow-coating linseed meal in one treatment (Fat + LSM), an equivalent amount of tallow was added to the entire ration for another treatment (Fat + Diet). This was done to determine if the fat was actually protecting the protein to improve performance or if it was simply providing additional energy. Performance of the steers is shown in table 1.

Table 1. Performance of Steers Fed Fat-coated LSM

	<i>Diet</i>		
	<i>No fat</i>	<i>Fat + LSM</i>	<i>Fat + Diet</i>
Daily gain, lb.	2.97	3.63	3.56
Daily feed intake, lb.	28.2	29.1	29.1
Feed/gain	9.50	8.02	8.15
% FE improvement	-----	+15.5	+14

Daily gains of steers fed the fat treatments were increased compared to no fat in the diet. These steers also consumed slightly more feed. Because of the increased gains by the steers, feed efficiency was improved with fat treatment by 15.5% for fat-coated LSM and by 14% for fat added to the diet. There was a slight advantage to coating the protein with the fat which may be significant in large feedlot operations.

This technique of coating proteins with fat for growing steers in the feedlot has the potential to improve the protein utilization by protecting the dietary protein. Further feedlot research with steers is needed to determine the reliability of the procedure and its economical advantages.

RUMEN BY-PASS IN CATTLE

G. T. Schelling, G. E. Mitchell, Jr. and R. E. Tucker

Adequate data is available to demonstrate that it would be advantageous to by-pass the rumen with certain nutrients. By avoiding access of the rumen microbes to certain nutrients, these nutrients can be directly digested and absorbed for use by the host animal. Thus, the inefficiencies of microbial metabolism would be eliminated. Based on the work conducted at the Kentucky Agricultural Experiment Station, as well as other stations, it appears that the by-passing of amino acids could be especially beneficial for improving the utilization of nitrogen by beef cattle and other ruminants.

Attempting Rumen By-pass With Chemical Derivatives

By slightly chemically modifying nutrients, it may be possible to create compounds which could not be metabolized by the rumen microbes but still be utilized as the nutrient by the host animal. Such a compound would successfully achieve rumen by-pass. DL-n-Hydroxy-methyl-methionine (calcium salt) (HMM) was investigated as a potential dietary methionine source for ruminants on the basis of previous work from this laboratory which indicated that HMM was more resistant to microbial degradation than methionine. The first trial involved mature sheep which were constantly infused duodenally with isomolar amounts of dl-methionine (MET) or HMM. The resulting plasma methionine concentrations were .020, .720 and .560 $\mu\text{M}/\text{ml}$ for the control, 8.0 g MET/day and 10.6 g HMM/day treatments. Six calves were used in a second trial to evaluate the plasma methionine response to feeding 33.2 g HMM/day in a basal diet. The plasma methionine concentrations for the preceding control, HMM treatment and subsequent control were .015, .012 and .015 $\mu\text{M}/\text{ml}$. The third trial consisted of ruminally administering higher levels of HMM to rumen cannulated steers. The treatment levels were based on metabolic body weight with the highest level being 75.6 HMM/day/steer. The plasma methionine values for the control and HMM treatment were .017 and .021 $\mu\text{M}/\text{ml}$ and were not statistically different ($P < .10$). The studies indicate that HMM can be utilized as a methionine source if it reaches the lower GI tract. However, these studies indicate that at most, only a limited amount of HMM survives degradation in the rumen. While this particular derivative does not appear to be successful, the search for others could be fruitful.

Attempting Rumen By-Pass by Nipple Feeding

In the newborn nursing ruminant, the esophageal groove functions to naturally by-pass the rumen. This is achieved by a physiological response which causes the muscular groove to form a temporary channel to direct milk from the esophagus through the reticulo-omasal orifice into the omasum. Thus, the milk does not enter the rumen or reticulum. The triggering mechanism is a nursing reflex which activates the esophageal groove only while nursing occurs. As a result, a calf drinking milk from a pail will not normally by-pass the rumen.

Experiments were conducted to investigate the potential for by-passing the rumen of various aged cattle with orally administered amino acids which were nipple-fed. The calves were nipple-fed a commercial milk replacer with or without lysine, histidine and arginine, each added at a level of .06% of metabolic body weight ($\text{BW}^{.75}$). In the first experiments the amino acids were added to milk replacer of 4-week old calves never exposed to dry feed. The amino acid treatment resulted in a considerable increase in the plasma levels of the 3 amino acids. The second experiment involved

10-week old calves which had been fed dry feed as well as milk replacer previous to the experiment and presumably had developed "functional" rumens. Milk replacer and dry concentrate were fed at levels of 1.0% and 3.0% dry matter per BW^{.75}. The treatments and plasma lysine, histidine and arginine concentrations 4-hr postfeeding were: (a) control; .24, .08, .16 (b) amino acids added to the dry feed; .25, .08, .19 (c) amino acids added to the milk replacer: .54, .68, .44. The third experiment involved 14-week old calves with "functional" rumens. The calves had been fed dry feed previous to the experiment, but during the experiment were fed only milk replacer (3.5% dry matter per BW^{.75}) without (a) and with (b) the added amino acids. The 2-hr postfeeding plasma concentrations were: lysine, (a) .24 (b) .48; histidine, (a) .09 (b) .40; arginine, (a) .25 (b) .43. The fourth experiment involved two-year old steers which were trained to nurse. When the steers were allowed to nurse a commercial milk replacer supplemented with lysine and methionine, the plasma levels of the amino acids increased 10-fold and 60-fold, respectively. Thus indicating definite rumen by-pass in nearly mature steers.

This work demonstrates that the esophageal groove functions not only in the young calf but also in two-year old cattle. Whether or not the esophageal groove could prove to be of practical benefit in production situations remains to be demonstrated.

AMINO ACID METABOLISM BY RUMEN MICROBES

R. L. Stuart, G. T. Schelling, R. E. Tucker and G. E. Mitchell, Jr.

The contribution of dietary protein to the amino acid supply for the ruminant depends on the extent to which it is hydrolyzed in the rumen. The action of ruminal microorganisms on dietary protein results in hydrolysis of some of the protein into peptides and amino acids which are then further metabolized by the microorganisms to meet their nutrient requirements. The result is that the amino acid pattern of dietary protein is changed to an amino acid pattern of the microbial protein. The microbial protein is subsequently passed down the ruminant's digestive tract, digested, absorbed and subsequently metabolized by the ruminant. The result of this is that the ruminant is mainly dependent on the ruminal microbial population to supply both the quantity and quality of amino acids to meet the animal's needs. It has been established that the amino acid pattern of microbial protein is not optimal for maximum animal performance, therefore, supplemental amino acids would improve nitrogen utilization. Due to rapid metabolism of free amino acids in ruminal fluid, it is nearly impossible to manipulate the pattern of amino acids that reach the duodenum of the animal by feeding free amino acids. Therefore, further knowledge of amino acid metabolism by the rumen microbes would be beneficial in order to plan a strategy which might be successful in by-passing the rumen.

The objective of the first study was to determine the location of amino acid degradation. This study indicated that the majority of amino acid disappearance was found to occur in association with the microbial cell, with methionine also being degraded in the extracellular fluid to a larger extent than the other amino acids tested. The percent disappearances for amino acids in whole ruminal fluid were significantly different. These differences could either be due to differences in permease activity or possibly due to competition for uptake among certain amino acids. Competition for uptake between alanine and glycine, serine and threonine and valine, leucine and isoleucine may exist in whole ruminal fluid. These data suggest that more than one enzyme is responsible for amino acid disappearance due to the great differences in percent amino acid disappearances determined in this study.

To determine if amino acid degradation occurred intracellularly or in association with the bacterial cell wall, ruminal bacterial cells were disrupted by French Press pressure disruption. Amino acid degradation was found to occur in both the bacterial cell content fraction and in the bacterial cell wall fraction. Alanine increased in both fractions, while proline, serine and threonine increased in the cell wall fraction. Methionine, valine and leucine were degraded in both fractions tested. These results are difficult to interpret because of possible interactions between bacterial cells that occur in the mixed culture of ruminal microorganisms. These interactions cannot be controlled or specifically defined.

The majority of bacteria responsible for amino acid degradation were found to be sedimented by 1000 x G centrifugal force. These bacteria are believed to be attached to particulate matter in ruminal fluid. In order to disrupt the attachment, blending in combination with a very low centrifugal force (50 x G) was used to prevent bacteria from sedimenting into the large particulate-matter pellet. Bacteria that utilize valine and leucine seem to be sensitive to the preparatory procedures used to obtain the bacteria because these two amino acids showed decreased disappearance rates when whole ruminal fluid was reconstituted.

To determine if amino acid deamination occurred in protozoa, defaunated ruminal fluid was tested to determine amino acid disappearance rates. The absence of protozoa did not affect amino acid deamination and it can be concluded that most amino acid deamination occurs in association with ruminal bacteria.

NUCLEIC ACID METABOLISM AND DIGESTION IN THE DIGESTIVE TRACT OF RUMINANTS

T. C. Jackson, Jr., G. T. Schelling, G. E. Mitchell, Jr. and R. E. Tucker

Nucleic acids are a group of organic compounds that perform many vital functions in the living cells of both plants and animals. In general nucleic acids provide the cell with all the information required to sustain life as well as functioning to transmit the information from parent to subsequent generations. Both plants and animals have the capabilities to synthesize nucleic acids and no dietary requirement has been established.

The diet represents the major exogenous source of nucleic acids in most animals. Ruminants, however, are unique in that the reticulum and rumen are inhabited by a flourishing microbial population which provides a steady flow of microbial mass to the lower gut. These microbes contain approximately 8 to 15% of their total nitrogen in the form of nucleic acid nitrogen. Several studies have indicated that degradation of dietary nucleic acids by the rumen microbes is essentially complete and, therefore, essentially all of the nucleic acids reaching the lower gut in ruminants are of microbial origin.

It was one purpose of this study to evaluate the relative amounts of nucleic acids, deoxyribonucleic acid (DNA) and ribonucleic acid (RNA), reaching the small intestine of ruminants fed either a natural diet or a urea-containing purified diet of equal nitrogen content in order to predict the microbial mass reaching the small intestine. The results indicated that nearly twice the amount of microbial matter reached the small intestine per day in sheep fed the natural diet as compared to those fed the urea-containing purified diet. It appeared that the protein and/or other factors present in the natural diet stimulated microbial production in the reticulorumen.

The nitrogen present in nucleic acids may be of limited use to the animal and as such would represent a nitrogen waste. Limited work has been conducted to quantitate the amount of total nitrogen present as nucleic acid nitrogen reaching the small intestine per day in ruminants. A second phase of this study was to estimate the percentage of total nitrogen present as nucleic acid nitrogen and the quantity of nucleic acid nitrogen reaching the small intestine per day. Studies were also conducted to estimate the nucleic absorption from the small intestine and the endogenous nucleic acid contribution to the small intestine. A new analytical procedure was developed that allowed for the rapid and accurate detection of the nitrogen containing purine and pyrimidine base components of nucleic acids in ingesta. Sheep fitted with duodenal and ileal re-entrant cannulas to exteriorize ingesta flow were used in this phase of the experiment. The results, described in table 1, indicate that approximately 12% of the protein plus nucleic acid nitrogen was in the form of nucleic acid nitrogen. The disappearance of nucleic acid nitrogen from the small intestine was about 89% indicating that the microbial nucleic acids are fairly efficiently digested and absorbed. The studies employed to measure the endogenous nucleic acid secretions into the small intestine indicated a relatively small amount of total secretion.

These studies, using sheep to represent the ruminant digestive tract, indicate that a significant amount of nitrogen is in the form of nucleic acids when it reaches the small intestine for absorption. While the nucleic acids are absorbed efficiently, other studies that have been conducted indicate that they are probably largely excreted in the urine without extensive oxidation. Thus, the nucleic acids not only represent a nitrogen loss, but also represent a loss of the energy required to synthesize them in the rumen.

Table 1. Nucleic Acid and Protein Nitrogen in the Digestive Tract of Sheep fed a Natural Diet

<i>Item</i>	<i>Quantity</i>
Nucleic Acid-Nitrogen Reaching the Small Intestine Daily	0.54 grams
Protein-Nitrogen Reaching the Small Intestine Daily	3.97 grams
Nucleic Acid-Nitrogen as a Percentage of Total Nucleic Acid-Nitrogen and Protein-Nitrogen	12.18 %
Percentage Nucleic Acid Absorption from the Small Intestine	88.97 %

LIVER ARGINASE ACTIVITY IN STEERS FED DIETS CONTAINING DIFFERENT LEVELS OF PROTEIN

J. A. Boling, P. J. Katanyukul, C. T. Nuzum and N. W. Bradley

Arginase is the terminal enzyme involved in the synthesis of urea via the hepatic urea cycle enzymes. When ruminants are fed protein, part of the protein is deaminated in the rumen to yield ammonia. A portion of the ammonia is synthesized into rumen microbial protein. The remaining ammonia is absorbed through the rumen wall and transported via the blood to the liver where it can be synthesized into urea. Ammonia is toxic to animal tissues, whereas urea is essentially not toxic to the tissues of the animal. This study was conducted to determine the response of liver arginase in growing-finishing steers to diets containing 9, 11 and 13% protein. Arginase assays were conducted on liver samples taken by aspiration biopsy on days 47 and 238 of the trial.

The composition of diets fed *ad libitum* are presented in table 1. Arginase activity after steers were fed these diets for 47 days are presented in table 2. Arginase activity was increased in steers fed the diets containing 11 and 13% protein as compared to those fed the diet containing 9% protein. A simultaneous increase in plasma urea nitrogen was observed as the dietary protein concentration increased. Arginase activity after steers were fed these same diets for 238 days are presented in table 3. At this sampling time, liver arginase activity increased as the level of dietary protein fed increased. Also, a concomitant increase in plasma urea nitrogen was observed as liver arginase activity increased. These data support previous observations in other species of the adaptive capacity of arginase to increased dietary protein.

Table 1. Composition of Diet Fed to Steers Containing Different Levels of Protein

Ingredient, %	Diet (% protein)		
	A(9%)	B(11%)	C(13%)
Cottonseed hulls	20.00	20.00	20.00
Cracked yellow corn	74.10	69.00	62.98
Soybean meal (44% CP)	3.50	9.70	15.80
Ground limestone	.65	.70	.72
Dicalcium phosphate	.25	.10	-----
Trace mineral salt	.50	.50	.50
Vitamin A, I.U./kg	4400	4400	4400

Table 2. Body Weight, Feed Intake, Arginase Activity and Plasma Urea-Nitrogen of Steers Fed Diets Containing Different Levels of Protein for 47 Days (Sampling 1)

	<i>Diet (% protein)</i>		
	<i>A(9%)</i>	<i>B(11%)</i>	<i>C(13%)</i>
Number of steers	6	5	6
Body weight (day 47), kg	272.41	282.73	273.18
Feed intake/day, kg ^a	9.89	11.10	9.05
<u>Arginase activity</u>			
μmole urea/mg protein/hr	224.8	327.8	333.3
Plasma urea-N (mg/100 ml)	4.44	8.55	12.22

^aFeed intake/day is the average daily feed intake for the 28-day period preceding biopsy.

Table 3. Body Weight, Feed Intake, Arginase Activity and Plasma Urea-Nitrogen of Steers Fed Diets Containing Different Levels of Protein for 238 Days (Sampling 2)

	<i>Diet (% protein)</i>		
	<i>A(9%)</i>	<i>B(11%)</i>	<i>C(13%)</i>
Number of steers	6	5	6
Body weight (day 238), kg	492.88	509.82	509.24
Feed intake/day, kg ^a	13.21	13.27	12.48
<u>Arginase activity</u>			
μmole urea/mg protein/hr	240.6	305.2	353.0
Plasma urea-N (mg/100 ml)	8.69	10.72	15.00

^aFeed intake/day is the average daily feed intake for the 16-day period preceding biopsy.

MAGNESIUM METABOLISM IN FALL-CALVING BEEF COWS

T. O. Okolo, J. A. Boling, N. Gay and N. W. Bradley

Grass tetany has been reported in Kentucky in both spring and fall-calving cows. Many feel that energy restriction among fall-calving beef cows accentuate both tetany and ketosis. Since fall-calving cows are usually much fatter going into the lactation phase of production than spring-calving cows, the following study was initiated to study the influence of magnesium and energy supplementation on cows going into the fall in different degrees of body condition (fat).

During the summer, 48 Angus cows were divided into two groups of 24 cows each. One group grazed sparse pasture so the cows would remain in thin-to-normal body condition. The remaining 24 cows were allowed to graze abundant pasture and were fed 2.3 kg shelled yellow corn per head daily. On August 21, just prior to calving, the cows were allotted to 3 treatment groups. The control group (A) consisted of 16 cows, 8 of which came from the thin cow group and 8 from the fat cow group. The magnesium oxide group (B) was comprised of 16 cows, 8 from the thin and 8 from the fat cow groups. Sixteen cows were similarly allotted to the energy supplemented group (C). The cows were assigned to pastures of 15 acres per treatment group, which had 100 pounds of ammonium nitrate applied per acre on July 23. Cows were rotated among pastures weekly. The cows in group B were fed 56.8 gm of MgO per head daily in 0.27 kg of an alfalfa meal, salt, molasses carrier which also contained added vitamin A. The cows in group C were fed 2.3 kg of shelled yellow corn per head daily as an energy supplement. Blood samples were taken by jugular puncture at 14-day intervals from November 5 through January 23 for serum Ca, Mg, K, free fatty acids and glucose.

The mean plasma values for the blood metabolites measured across all sampling times for the 3 fall treatment groups are presented in table 1.

Table 1. Mean Serum Magnesium, Calcium, Potassium, Urea-Nitrogen, Glucose and Free Fatty Acid Levels in Fall-Calving Beef Cows

	<i>Treatment</i>		
	<i>Control</i>	<i>MgO Suppl.</i>	<i>Energy Suppl.</i>
Magnesium ^a	1.9	2.5	2.1
Calcium ^a	8.5	8.1	8.2
Potassium ^b	5.1	5.2	5.2
Urea-N ^a	13.4	16.5	10.2
Glucose ^a	38.2	37.1	38.7
Free fatty acids ^c	57.8	59.1	53.0

^aMg/100 ml plasma

^bMeq/liter

^cμeq/liter

Plasma Mg was highest in the MgO supplemented group, as was expected. Calcium tended to be high in the control group of cows. Overall potassium and glucose values were similar for the 3 treatment groups. Plasma urea-N and free fatty acids were lowest in the energy supplemented group of cows. One cow in the energy group died of tetany. At the bleeding prior to the onset of tetany, the cow had lowered blood Mg, K, urea-N and slightly elevated glucose and free fatty acids as compared to the mean values presented in table 1. The overall values in table 1 do not show the time differences observed or the response of the fat versus thin cows within each treatment. The differences observed at the different blood sampling times and the blood changes noted owing to supplementation with magnesium and energy warrant further investigation into the role of body condition and type of supplementation on magnesium metabolism and the onset of tetany.

BLOOD METABOLITES IN SPRING-CALVING COWS EXHIBITING GRASS TETANY

T. O. Okolo, J. A. Boling, N. Gay and G. Lacefield

Grass tetany is most prevalent in Kentucky among spring-calving cows when the grass is very lush. It is well documented that lowered serum magnesium is associated with grass tetany, indicating that the disturbance is related to a metabolic deficiency of magnesium. The role of energy as related to magnesium metabolism in the lactating beef cow has not been fully elucidated. This experiment was designed to study the influence of Mg and Mg plus energy supplementation on the incidence of tetany and blood metabolites of spring-calving beef cows.

Forty-eight spring-calving cows were utilized to compare the effects of heavy fertilization, energy and magnesium supplementation on serum metabolites in spring tetany. In September prior to the study, the tetany prone pasture was prepared by applying 60, 22 and 124.5 pounds of N, P, K fertilizer per acre. On January 1, the cows were randomly allotted to 3 groups containing 15 cows each. Group A was designated as the tetany group and grazed the tetany prone pasture. They received neither energy or MgO supplementation but were given a mineral mixture *ad libitum* which consisted of one-third plain salt, trace mineral salt and steamed bone meal. Group B cows grazed the normal pasture field and were designated as the no energy group. They did not receive supplemental energy but were fed a mineral mixture containing 40% MgO, 20% plain salt, 20% trace mineral salt and 20% steamed bone meal. Group C, designated as the energy group, grazed the normal pasture, were fed 3.6 kg per head daily of corn silage and were offered *ad libitum* the same mineral mixture as group B. The cows were bled by jugular puncture at 14-day intervals from February 25 through May 13 for blood analyses. Blood samples were also taken from cows which exhibited tetany.

Blood metabolite values across all sampling times for the 3 treatment groups are presented in table 1. Cows in the tetany group had lower serum Mg than cows in either groups B or C. Blood Ca and K were similar among the 3 treatment groups. The energy supplemented cows had the highest mean serum Mg concentrations. Cows in group A were highest in serum free fatty acids, glucose and urea-N and the energy supplemented group C lowest in these same measurements. Five cows in group A and one cow in group B had tetany (spasms). The cows in group A during tetany had the following blood serum values: Mg (0.42 mg/100 ml), Ca (6.4 mg/100 ml), K (3.5 Meq/liter), FFA (45.2 μ eq/liter), glucose (34.0 mg/100 ml) and urea-N (18.4 mg/100 ml). These data show that at the time of tetany onset, the cows were both hypomagnesemic, hypocalcemic and had lowered blood glucose. An examination of blood metabolite patterns prior to the onset of tetany indicated a consistent decline in blood magnesium until the onset of tetany occurred. The changes observed with time for free fatty acids and glucose are likely reflective of the utilization of body energy stores for current energy needs and/or the influence of Mg on the metabolism of these two principal energy sources.

Table 1. Mean Serum Magnesium, Calcium, Potassium, Free Fatty Acid, Glucose and Urea-Nitrogen Levels in Spring-Calving Cows

	<i>Treatment</i>		
	<i>A</i>	<i>B</i>	<i>C</i>
Magnesium ^a	1.3	2.0	2.5
Calcium ^a	9.7	9.7	9.7
Potassium ^b	4.4	4.6	4.3
Free fatty acids ^c	61.3	47.1	43.0
Glucose ^a	41.1	39.8	37.9
Urea-N ^a	21.1	20.7	17.3

^amg/100 ml plasma.

^bMeq/liter.

^cμeq/liter.

MINERAL UTILIZATION IN SHEEP AT HIGH TEMPERATURES

M. C. DaRocha, R. E. Tucker, G. E. Mitchell, Jr. and G. T. Schelling

Environmental chambers were used at 35 and 20° C to measure calcium, phosphorus and magnesium utilization in 16 wether lambs kept for 2 trials of 20 days adjustment and 6 days of total fecal and urinary collections. Chopped dehydrated fescue hay was fed at 500 g per head twice daily with measured water intake. In trial 1, the high temperature increased water intake (6663 vs. 2661 ml per day). The increased water intake allowed greater calcium intake via the water source, and consequently calcium balance was higher for the lambs with the greater calcium intake (15 vs. 7.2 g per day). Phosphorus retention was greater in the low temperature group (170 vs. 60 mg per day).

Water consumption was not different in the second trial. Although the second adjustment period of 20 days should have minimized carryover effects, the animals previously in the high temperature group maintained a high water intake when switched to the 20° environment. This negated the differences in calcium balance observed in trial 1. However, the phosphorus balance was again reduced by the high temperature. Dry matter digestibility was similar (59) in both trials at both temperatures. These data suggest that high environmental temperatures are detrimental toward phosphorus utilization.

MINERAL BALANCE IN SHEEP FED EARLY SPRING DEHYDRATED FORAGES

C. R. Rosero, R. E. Tucker, G. E. Mitchell, Jr. and G. T. Schelling

Kenhy fescue or orchardgrass at 2 levels of nitrogen fertilization were harvested early, April 23, or late, June 5, and dehydrated in an oil-fired rotary drier. The dehydrated forages were fed to sheep in metabolism stalls to measure magnesium, potassium, sodium, calcium and nitrogen utilization. Analyses of the forage, feces and urine revealed that significantly less magnesium was retained by the sheep fed the early forages. Nitrogen fertilization tended to lower magnesium intake, percent absorbed and retained. There was no difference in orchardgrass or Kenhy fescue in magnesium retained by the sheep. Sodium, potassium and nitrogen utilization were similar for each forage species or level of fertilization. The early cut forages provided a higher nitrogen retention which is in keeping with the well known decrease in forage quality with increasing maturity. Orchardgrass provided a higher calcium retention than Kenhy fescue.

In another set of experiments, the dehydrated forage was fed then followed by forced water consumption to equal the 90% water content of lush pasture. Voluntary feed intake was reduced and, consequently, overshadowed the forage species, maturity and fertilization effects observed in the first experiments. However, the reduced feed intake may be an important factor in magnesium deficiency associated with very early forage.

Less than 3% of the plant magnesium was found in the chlorophyll. Although chlorophyll is largely undigested, the amount of magnesium in this fraction should not greatly affect over all magnesium utilization.

STABILITY OF VITAMIN A AND CHLORTETRACYCLINE ADDED TO LIQUID SUPPLEMENTS FOR BEEF CATTLE

G. L. Newton, R. E. Tucker, G. E. Mitchell, Jr. and G. T. Schelling

Water dispersable vitamin A (60,000 IU/lb) and chlortetracycline (70 mg/lb) were stored at -22, 32, 68, 95 and 122° F for periods up to 6 months. The basal supplement contained 55.4% cane molasses, 9% ammonium polyphosphate, 17% urea, 17.5% water and 0.3% mineral mix. Well mixed samples were withdrawn at frequent intervals for assay of vitamin A by chemical methods and by measuring chick liver storage. This was necessary because vitamin A can change chemical form and retain its potency by chemical assay but have little or no biological value.

The chlortetracycline was assayed by standard antibiotic microbial methods. It soon became apparent that chlortetracycline is not stable in this type of supplement. More than half of the antibiotic activity disappeared by the second day of storage at 122°F. Stability was only slightly improved at 68°F which allowed 10 days of storage before losing half the original potency. These observations indicate that it is impractical to add chlortetracycline to liquid supplements. The vitamin A was much more stable. One half of the original biopotency could be measured after 125 days of storage at 68°F. This compares with 291 days at 32°F and 34 days at 95°F. At 122°F, 50% biopotency loss occurred in only 15 days. If the vitamin A stability had been estimated from chemical assay only, slightly longer decay times would have been calculated.

EVALUATION OF FOUR VARIETIES OF TALL FESCUE FOR YEARLING STEERS DURING THE SPRING-SUMMER GRAZING SEASON

W. W. Steen, N. Gay, J. A. Boling, R. Buckner, L. Bush,
J. McCormick and Gary Lacefield

Since the 1930's tall fescue has become the major cool season grass in Kentucky. Ky 31 was first discovered in 1931 by E. N. Fergus in Menifee County. It had apparently been introduced from Europe and came from Virginia to Mr. Suiters farm in Menifee County. Ky 31 became widely used due to several desirable traits: excellent soil conservation qualities, wide adaptability of the plant with regard to soil type and climatic conditions, ability of Ky 31 to grow well in poorly drained soils and to withstand drought and, also, promote adequate performance under pasture conditions.

There are a number of problems that have been observed in cattle grazing tall fescue. Fescue foot, fat necrosis and poor animal performance have all been noticed under experimental conditions as well as in the field. In general, the tall fescues have had problems with palatability and intake which undoubtedly are related. There are also a number of alkaloids, most notably perloline and perlolidine that are present in tall fescue. Both perloline and perlolidine have been reported to decrease cellulose digestion in laboratory fermentations (*in vitro* fermentations). The decreased cellulose digestion due to the effects of the alkaloids could lower the amount of energy available to the animal, thereby reducing performance. Perloline and perlolidine accumulates in tall fescue during late July and August when poor animal performance is most often observed.

Work at the University of Kentucky in improving tall fescue has led to the development of several new selections. Kenhy has recently been released by Dr. Robert Buckner at the University of Kentucky. Dr. Buckner has also worked in the development of two strains of ryegrass hybrids x tall fescue selected for high and low perloline content. These developments led to the initiation of a study to evaluate Ky 31, Kenhy and the high perloline strain (G1-306) and the high perloline strain (G1-306) and the low perloline strain (G1-307) of tall fescue, with animal growth studies.

Eight pastures, each approximately 4 acres in size, were seeded in late August 1975 to each of the four tall fescues: Ky 31, G1-306, G1-307 and Kenhy. All pastures were pure stands of tall fescue. The only fertilization applied was ammonium nitrate (NH_4NO_3). Forty pounds N/acre was applied prior to seeding and an additional 33 pounds N/acre was applied on March 1, May 25 and August 1, 1976. Pastures were divided into 2 equal halves by electric fence to allow rotational grazing. All pastures were kept below 6 inches in height to prevent the fescue from becoming mature. This increased the quality of the forage the steers were consuming.

Thirty-six steers were grazed from March 24 to September 3, 1976. Each variety had the number of steers indicated in table 1. Full and shrunk weights were obtained during the experiment. Rectal temperatures, respiration rates and hematocrits were obtained on each steer. Respiration rates were taken while the steers grazed undisturbed and rectal temperatures were recorded on steers that were not extremely stressed.

Table 1 presents the performance data for the steers on each of the 4 tall fescues. Steers grazing the low perloline (G1-307) were lighter and had the poorest average daily gain during the spring-summer steers grazing the other selections of tall fescue. Although no real differences were observed in the rectal temperatures of the steers grazing each fescue, the steers on G1-307 tended to have higher rectal temperatures. Hematocrit was higher in the steers grazing G1-306 with no differences between the other three fescues.

Table 1. Performance and Physiological Response of Steers Grazing the Four Varieties of Tall Fescue

	<i>Treatment</i>			
	<i>Ky 31</i>	<i>G1-306</i>	<i>G1-307</i>	<i>Kenhy</i>
Number of steers	10	7	10	9
Avg. full weight, lb.	736	769	724	772
Avg. daily gain, shrunk, lb.	.92	.84	.64	.88
Respiration rate, breaths/min	66.0	63.4	81.5	64.8
Hematocrit, %	40.8	45.74	41.6	41.1
Rectal temperature, °F	101.6	101.7	102.4	101.8

Steers grazing G1-307 had long, rough, lusterless haircoats even during the summer when all other steers on Ky 31, G1-306 or Kenhy had smooth, shining haircoats. The steers grazing G1-307 were also emaciated and generally in poor condition. These cattle spent most of the day laying under shades and in any available mud and water. They were obviously very sensitive to heat stress. The reasons for the poor performance and increased respiration rate cannot be attributed to the presence of perloline or perlolidine. Analysis of the forage indicated that G1-307 was significantly lower in both alkaloids. Differences in intake complicate the interpretation of pasture studies. Additional work at Lexington where green chop was fed, indicates lower intake of G1-307 as well as similar observations on the cattle as seen in this pasture study. The identification of increased amounts of other alkaloids and other "anti-quality" factors in G1-307 may account for the unexpected poor performance of cattle grazing this strain of tall fescue. Future work on this forage and other fescues is directed toward potential improvement of tall fescue.

RELATIONSHIP OF BREED AND SEX ON BEEF MUSCLE FIBER TRAITS

David Johnston, W. G. Moody and Neil Bradley

There are many factors that have been shown to influence the size and population of muscle fiber types. The two that will be discussed here are breed and sex as they may relate to differences in fiber type percentages and fiber diameter.

Individual animals and even muscles within an animal differ in the rate at which fibers and enzymes in the fibers differentiate. Small animals such as mice and rats may be misleading models with which to attempt an understanding of muscle growth and development in meat animals. There appears to be no consistent relationship between body weight and mean fiber diameter of different species at birth. The order of relative increase in fiber size from birth to maturity corresponds with that of body weight increase. At maturity, pigs have the largest mean diameter followed by rabbits, cattle and sheep.

In cattle some work has shown significant breed effects on fiber diameter of untyped fibers, whereas, other work has not shown any effect. When individual fiber types are observed, breed has been shown to affect the fiber diameter and population of fibers in a particular muscle. However, little work has been done to compare breed and breed crosses along this line.

The results of sex comparisons in cattle with regard to fiber size and type are very inconsistent. After puberty, males have been reported to have larger fiber diameters than females. Again, this is not consistent between muscles when comparing males and females.

For these reasons, a more detailed study on fiber types was undertaken to help explain the relationship that sex and breed may have on animal growth and subsequent meat quality.

The animals used in this study involved 96 cattle of 2 sexes (steers, heifers) and 3 breed groups (straightbred Angus, 75% Angus x 25% Hereford, 50% Angus x 25% Hereford x 25% Holstein). Each sex x breed treatment group contained 8 cattle. Animals were slaughtered when the group appeared to average low choice.

The Simmental crossbred cattle originated from another study involving 48 steers that were part of the nutritional studies that will be discussed later.

Histological samples were processed in the fresh unfrozen state. Samples from the *longissimus* muscle were removed from the seventh thoracic region. Small sections (1 cm) of tissue were removed from the muscle so that the fibers were parallel to the sides of the section. Samples were rolled in flour before being cryogenically frozen in dry ice-acetone mixture. The tissue was reacted with DPNH-TR, Sudan Black B and myofibrillar ATPase assayed at an alkaline PH. Photomicrographs of each sample were taken to obtain 4 bundles containing less than 50 fibers, 4 containing 50 to 100 fibers and 2 containing 100 fibers. The diameters of each of the 3 fiber types were measured with a zeiss particle size analyzer.

Table 1 contains the histological means of beef *longissimus* muscle from the various breed crosses. There was no significant difference in percent fibers or diameters in the 3 groups containing Angus breeding. The Simmental cattle had a slightly higher percent of α W fibers and a lower percent of β R fibers than the other 3 groups. This may have been due to the fact that these cattle were a later maturing type with more (α W) white fibers. The increase in both numbers and size of α W fibers is fairly typical of cattle containing exotic breeding.

Table 1. Mean Histological Values for Straight & Crossbred Cattle

	<i>Straight Angus</i>	<i>3/4 Angus 1/4 Hereford</i>	<i>1/2 Holstein 1/2 Angus 1/4 Hereford</i>	<i>Simmental Cross</i>
LD Muscle				
Fiber type, %				
β R	29.1	29.2	29.3	23.6
α R	21.7	22.8	22.2	22.7
α W	49.2	48.2	48.6	53.8
LD Muscle				
Fiber Diam., μ m				
β R	44.9	45.4	43.2	36.1
α R	38.6	40.7	39.3	34.4
α W	44.3	46.1	46.1	39.6

In table 2 it can be seen that bundle size had no effect on the fiber diameters of any of the 3 fiber types. The β R fiber population (%) increased significantly ($P < .01$) as bundle size increased; whereas, the α R fiber population decreased significantly ($P < .05$). The α W fiber population was apparently unaffected by bundle size as the population was similar in all 3 bundle sizes.

Table 2. Mean Histological Values for 3 Muscle Bundle Sizes

	<i>Muscle Bundle Size</i>		
	<i>Small < 50 fibers</i>	<i>Medium 50 to 100 fibers</i>	<i>Large > 100 fibers</i>
LG Muscle			
Fiber type, %			
β R	28.5**	29.7	30.1
α R	22.8*	21.8	21.5
α W	48.8	48.7	48.4
LD Muscle			
Fiber Diam., μ m			
β R	44.6	44.2	44.5
α R	39.2	39.8	39.3
α W	45.5	45.4	45.6

*($P < .05$) means within columns differ significantly.

**($P < .01$).

The effect of sex on the histological traits is reported in table 3. The steer *longissimus* had significantly ($P < .05$) more β R fibers than that of the heifers; however, sex had no effect on the α R or α W fiber numbers. The fiber type diameters and β R and α R fiber percents were also unaffected by sex, although the steer *longissimus* had a higher β R fiber population that approached the 5% level of significance. The α W fiber population was significantly ($P < .05$) higher in the heifer *longissimus* by about 2%.

Table 3. Mean Histological Values for Steer & Heifers

	<i>Steers</i>	<i>Heifers</i>
LD Muscle		
<u>Fiber type, %</u>		
β R	30.1	28.1
α R	22.3	22.1
α W	47.6	49.9*
LD Muscle		
<u>Fiber Diam., μm</u>		
β R	44.0	45.0
α R	39.2	39.9
α W	45.3	45.8

*($P < .05$).

RELATIONSHIP OF FEEDING METHODS ON BEEF MUSCLE FIBER CHARACTERISTICS

David Johnston, W. G. Moody and Neil Bradley

The information on the effect of different feeding methods on fiber size and population is very limited. The severity and duration of a low plane of nutrition is very important in relation to the age of an animal. Low nutrition has more effect on animals undergoing a rapid growth rate during the first few months of life. Generally speaking, as the energy levels in a ration increase, fiber diameter decreases. Previous work at this station has shown that as protein content of the diet increased from 9% to 13% there was a trend toward a linear decrease in fiber diameter and area for all 3 fiber types.

Until the last few years, most measurements of fiber size and distribution have been made on untyped fibers. Work has shown that as age increases, fiber diameter or area increases significantly in most animals. Some work with cattle has shown that *longissimus* fiber diameter increases 11% between 1 and 7 months but 42% between 7 and 14 months of age. The rapid increase was subsequent to the time bone growth attained its major part of development and perhaps when the fibers had completed most of their metabolic adaption.

The growth curve of fiber diameter or area due to advancing age is curvilinear. The percentage of β R, α R and α W fibers in the population has been reported to remain essentially unchanged due to increasing age in cattle. Major shifts in muscle fiber types have been observed in PSE susceptible pigs and double muscled cattle.

Little work has been done to compare the effects of nutrition on fiber types particularly as it pertains to cattle on roughage vs grain and alterations in feeding management systems such as described in this study.

The cattle described in this study were divided into 2 experiments. The first experiment consisted of 96 Angus and Angus cross cattle which were divided equally into 2 feeding groups. The first group was fed a normal feedlot ration; whereas, the second group was fed grain on grass. Again, as in the previous experiment all cattle were slaughtered when the average of the group appeared to grade choice.

The second study was a 2 x 4 factorial involving 96 steers of 2 breed groups (Angus and Simmental cross) and 4 feeding methods (weaned, weaned + 20 bu. corn, overwintered on grass + 20 bu. corn and overwintered and oversummered on grass + 20 bu. corn).

At slaughter the grain fed Angus cross cattle were approximately 16 months old while the grain on grass group was about 20 months old. In the second study, at slaughter the weaning group was approximately 7 months old, the weaning plus 20 bu. corn approximately 10 months, the overwintered group about 17 months and the overwintered and oversummered group approximately 19 months of age.

The histological procedure was the same as described in the previous paper.

Table 1 shows the muscle fiber characteristics of grain and grain on grass fed cattle. The grain fed cattle tended to have a higher percent of β R fibers in the *longissimus* than the grain on grass fed cattle. The grain fed cattle had significantly fewer α R ($P < .01$) fibers in the fiber population and more α W ($P < .01$) fibers than did that of the grain on grass fed cattle. All 3 fiber types had similar diameters in both feeding methods.

Table 1. Mean Histological Values Comparing 2 Cattle Feeding Methods

	<i>Grain fed</i>	<i>Grain or grass</i>
LD Muscle		
<u>Fiber type, %</u>		
β R	29.6	28.7
α R	20.5**	23.9
α W	50.0**	47.4
LD Muscle		
<u>Fiber Diam., μm</u>		
β R	43.6	45.3
α R	40.0	39.1
α W	46.1	45.0

**($P < .01$) means within columns differ significantly.

Table 2 compared the histological data among feeding groups. The Angus steers increased ($P < .01$) in percent β R fiber within the population over the first 2 feeding methods (weaners and grain fed weaners) then plateaued while the Simmental cross steers increased over the first 3 methods (weaners, grain fed weaners and overwintered) then decreased somewhat. The percent α R fibers in the population in the *longissimus* of the Angus decreased slightly over the increased time of feeding while in that of the Simmental the population of α R fibers increased. Fiber diameters appeared unaffected by the feeding methods.

Table 3 shows the effect of bundle size on the histological traits. Bundle size had no effect on the diameters or percentages of each of the 3 fiber types. The β R fibers in all 3 bundle sizes had diameters about 2 μ m larger than those of the α R fibers, but about 4 μ m smaller than the α W fiber diameters.

Table 2. Mean Histological Values Compared by Growth and Feeding Treatment Groups

	<i>Non-fed weaners</i>		<i>Grain-fed weaners</i>		<i>Over-wintered</i>		<i>Over-summered</i>	
	<i>Angus</i>	<i>Simmental</i>	<i>Angus</i>	<i>Simmental</i>	<i>A</i>	<i>S</i>	<i>A</i>	<i>S</i>
LD Muscle								
Fiber type, %								
β R	19.2**	19.4	25.6	23.5	24.9	28.3	25.5	24.1
α R	22.8**	21.5	21.5	23.0	23.7	20.4	21.5	25.2
α W	58.2	59.1	53.7	53.7	51.5	50.6	53.0	51.0
LD Muscle								
Fiber Diam., μ m								
β R	29.7	28.6	37.2	37.7	38.9	38.6	39.9	39.7
α R	30.4	30.9	34.5	34.7	35.5	36.8	35.6	35.5
α W	37.1	37.3	40.3	39.3	43.4	41.1	41.4	41.2

**($P < .01$) means within columns differ significantly.

A = Angus

S = Simmental

Table 3. Mean Histological Values for Three Muscle Bundle Sizes by Growth and Feeding Treatment Groups

	<i>Small</i> <i>< 50 fibers</i>	<i>Medium</i> <i>50 to 100 fibers</i>	<i>Large</i> <i>> 100 fibers</i>
LD Muscle			
Fiber type, %			
β R	23.8	23.5	24.3
α R	22.1	22.9	22.5
α W	54.1	54.0	53.3
LD Muscle			
Fiber Diam., μ m			
β R	36.4	36.4	36.0
α R	34.4	34.2	33.8
α W	40.2	40.3	39.6

RELATIONSHIP OF MUSCLE FIBER CHARACTERISTICS ON BEEF PALATABILITY AND CARCASS TRAITS

David Johnston, W. G. Moody and Neil Bradley

Efforts have been made to relate muscle fiber size to carcass quantitative and qualitative traits for many years. A good relationship of fiber size with carcass characteristics could be useful in the selection of improved meat animals. The Armour Tenderometer has been used on carcass meat to predict meat tenderness. Only a few studies have correlated fiber types with carcass characteristics.

Work relating fiber diameter to proximate analysis values of the *longissimus* has yielded variable results. Fiber diameter has been found to be correlated with flavor and juiciness while muscle bundle size has been shown to be positively correlated with shear and texture scores and negatively correlated with tenderness.

The present study was undertaken to compare individual fiber components with various palatability and carcass traits.

The cattle used in this study have been previously described by Johnston *et al.* Samples were taken from the 9th to 11th rib section of the *longissimus* from both cattle studies. The meat was aged for 5 days at 2.2°C in a conventional cooler before the muscles were dissected from the carcass. It was then frozen at -20°C until needed.

Steaks were cut 3.2 cm thick and cooled to 67.8°C. Duplicate samples of the *longissimus* were given to an experienced 7-member panel for evaluation on a 1 to 9 hedonic scale. In this scale 1 represents dislike extremely, while 9 represents like extremely.

Samples of the *longissimus* were analyzed for percent moisture, fat and crude protein by recommended A.O.A.C. methods. The histological procedure was the same as described earlier.

The correlations of histological traits with taste panel scores and shear are reported in table 1. The β R and α R fiber diameter were significantly ($P < .05$) correlated with the panel tenderness score (-.25 and -.21 respectively) and shear values of the roasted meat (.22 and .21 respectively). The α W diameter was significantly correlated with overall satisfaction (-.24).

Table 1. Correlations Between Fiber Diameter and Taste Panel Scores

	<i>Tenderness</i>	<i>Flavor</i>	<i>Juiciness</i>	<i>Overall Satisfaction</i>	<i>Shear</i>
LD Muscle					
Fiber Diam., μ m					
β R	-.25*	.08	-.17	-.20	.22*
α R	-.21*	.10	-.04	-.17	.21*
α W	-.18	.06	-.05	-.24*	.11

* $P < .05$.

Correlations of histological traits between carcass grades and grading factors are illustrated in table 2. The α R fiber diameter was correlated with quality grade (.30). As the percent of α W fibers

increased in the population, the carcass weight, Armour Tenderometer, backfat thickness and marbling score all decreased. The percent β R fibers was correlated with yield grade (.22).

Table 2. Correlations of Histological Traits Between Carcass Grades and Grading Factors

	<i>Carcass weight</i>	<i>Backfat TH</i>	<i>Marbling scores</i>	<i>REA</i>	<i>Quality grade</i>	<i>Yield grade</i>
LD Muscle						
Fiber type, %						
β R	.17	.19	.15	.03	.15	.22*
α	.18	.01	.04	.06	-.07	.08
α	-.37**	-.24*	-.22*	.00	-.11	-.10
LD Muscle						
Fiber Diam., μ m						
β R	.14	.14	.01	.03	.15	.17
α R	.05	-.06	.02	.10	.30**	-.06
α W	.09	-.10	.02	.18	.19	-.09

*($P < .05$).

**($P < .01$) means within columns differ significantly.

In table 3 it can be seen that the percent β R fibers was correlated with percent and dissectable fat of the *longissimus* muscle. The percent of α W fibers was significantly correlated ($P < .01$) with Armour Tenderometer (.34), % fat of the *longissimus* (-.29) and % dissectable fat of 9-11th rib (.33). All fiber type diameters were significantly correlated with dissectable fat of 9th to 11th rib. Only the α W fiber diameter was significantly ($P < .05$) correlated with percent protein of the *longissimus* muscle.

Table 3. Correlations of Histological Traits Between Armour Tenderometer and Muscle Composition

		<i>Chemical comp.</i>			<i>Physical comp.</i>	
	<i>Armour</i>	<i>Water</i>	<i>Protein</i>	<i>Fat</i>	<i>9-11th</i>	<i>9-11th</i>
	<i>Tenderometer</i>	%	%	%	<i>Rib</i>	<i>Rib</i>
					<i>fat, %</i>	<i>lean, %</i>
LD Muscle						
<u>Fiber type, %</u>						
βR	.00	.06	.04	.24*	.32**	-.25
αR	-.02	-.22*	.03	.02	.08	-.10
αW	.34**	.14	-.08	-.29**	.33**	.30*
LD Muscle						
<u>Fiber Diam., μm</u>						
βR	.12	.09	.04	.00	.45**	.05
αR	.03	-.16	.11	-.03	.27*	.08
αW	-.07	.20	-.23*	.05	.25*	-.00

* $P < .05$.**($P < .01$) means within columns differ significantly.

EFFECTS OF THAWING METHODS AND SUBSEQUENT COOKERY ON BEEF QUALITY AND EATING TRAITS

Carola Bedau and W. G. Moody

Meat quality and consumer satisfaction have been a concern of researchers and producers for many years. The effects of cooking time, temperature and methods of cooking on meat quality have been studied widely over the years. Frozen storage of meat and its effect on meat quality is becoming increasingly important in a world where time and convenience have the priority. Freezing of meat is generally considered to be the most damaging phase of the entire meat handling process.

Even with all the research done to date to improve meat quality, relatively little work has been done to compare methods of thawing prior to cooking.

The purpose of this study was to determine the effects of thawing and cooking methods and freezer storage on the microbial, sensory and mechanical qualities of beef roasts and steaks.

Four different thawing procedures were used to cook 5 and 10 month freezer storage steaks and roasts. The meat was cooked either (1) in a conventional electric oven or in an Amana Radarange after having been thawed in the refrigerator (3.3C), (2) thawed overnight at room temperature, (3) cooked frozen or (4) defrosted and cooked in the Radarange. In order for steaks to be thawed completely (approx. -2°C) they were held in the refrigerator for 48 hours prior to cooking. Roasts required about 4 days in the refrigerator to thaw to the desired stage.

Total plate counts were run on 24 roasts from each of the 2 storage periods. The swab-rinse method was used on the refrigerator, room and microwave-thawed roasts. All sampling was done immediately prior to cooking, except for the microwave-thawed roasts, which were not swabbed until after the defrosting and resting cycle was completed. Dilutions up to 10^{-4} were run on frozen and microwave roasts, and dilutions up to 10^{-5} were run on the room and refrigerator roasts. Samples were plated in duplicate using Plate Count Agar.

Tables 1 and 2 show the mean palatability and cooking values together with the t-values for individual comparisons for roasts and steaks thawing by different methods. The highest mean value for flavor was reported for the fresh roasts. This would suggest that freezing has an effect on the flavor of beef. Comparing only the roasts which were frozen and subsequently either thawed or cooked frozen, the highest mean panel flavor value was for the room temperature thawed roasts. The same trend is also seen for the other 4 variables. There was no difference in mean flavor values for roasts either thawed in the refrigerator or in the microwave oven. The roasts which were cooked frozen obtained the lowest mean flavor score. The microwave-thawed roasts turned out to have the lowest values for juiciness, tenderness and overall satisfaction.

The shear values were also higher (less tender) for both steaks and roasts thawed and subsequently cooked by microwave methods.

Table 3 gives the t-values for shear and cooking loss of both steaks and roasts. Fresh versus room-thawed, room thawed versus microwave-thawed, and refrigerator-thawed versus microwave-thawed roasts were significantly different at .01 probability level.

Of these, the greatest t-values were observed for the room-thawed versus the microwave roasts. Fresh versus refrigerator-thawed and microwave-thawed versus cooked frozen roasts were significantly different. The same general trends were true for the steaks.

Total cooking loss was greater for the microwave cooked meat. The greatest mean cooking loss expressed as percent of raw weight was observed for the steaks which were cooked frozen.

Table 1. Effect of Thawing Method on Mean Sensory and Shear Values of Roast and Steaks

<i>Method of thawing</i>	<i>Roasts</i>		<i>Steaks</i>	
	$\bar{X}$	STD	$\bar{X}$	STD
<i>Fresh</i>				
Flavor ^a	7.1 ± 0.3		6.9 ± 0.3	
Juiciness	6.3 ± 0.5		6.7 ± 0.6	
Tenderness	7.4 ± 0.4		7.1 ± 0.5	
O. satisfaction	6.6 ± 1.3		6.8 ± 0.4	
Shear ^b	8.8 ± 1.4		8.6 ± 1.0	
Cooking loss, %	19.1		17.0	
<i>Room temp.</i>				
Flavor ^a	6.8 ± 0.5		6.9 ± 0.3	
Juiciness	6.7 ± 0.7		6.8 ± 0.4	
Tenderness	7.5 ± 0.4		7.2 ± 0.5	
O. satisfaction	6.7 ± 0.5		6.7 ± 0.4	
Shear ^b	8.0 ± 1.4		8.0 ± 1.2	
Cooking loss, %	19.1		19.9	
<i>Refrigerator</i>				
Flavor ^a	6.7 ± 0.5		6.9 ± 0.4	
Juiciness	6.5 ± 0.6		6.9 ± 0.6	
Tenderness	7.2 ± 0.6		7.0 ± 0.6	
O. satisfaction	6.4 ± 0.6		6.8 ± 0.5	
Shear ^b	8.1 ± 1.4		9.5 ± 1.9	
Cooking loss, %	20.6		22.1	
<i>Microwave</i>				
Flavor ^a	6.7 ± 0.4		6.8 ± 0.3	
Juiciness	6.2 ± 1.0		6.8 ± 0.7	
Tenderness	6.8 ± 0.8		6.9 ± 0.7	
O. satisfaction	6.3 ± 0.6		6.6 ± 0.5	
Shear	9.0 ± 1.6		9.7 ± 1.8	
Cooking loss, %	28.9		18.9	
<i>Cooked frozen</i>				
Flavor ^a	6.6 ± 0.5		6.9 ± 0.4	
Juiciness	6.4 ± 0.7		6.7 ± 0.4	
Tenderness	7.2 ± 0.6		6.9 ± 0.6	
O. satisfaction	6.5 ± 0.5		6.6 ± 0.4	
Shear	8.4 ± 1.5		9.1 ± 1.6	
Cooking loss, %	20.0		23.4	

^aHedonic scale, 1-9: 1 = dislike extremely, 9 = like extremely^b = (kg)/2.54 cm.

Table 2. t-values for Sensory Characteristics of Roast and Steaks

	<i>Tenderness</i>		<i>Juiciness</i>		<i>Flavor</i>	
	<i>Roast</i>	<i>Steaks</i>	<i>Roast</i>	<i>Steaks</i>	<i>Roast</i>	<i>Steaks</i>
Fresh vs room	-0.58	-0.64	-2.22	-0.43	2.74*	0.07
Fresh vs refrigerator	1.47	0.79	-1.21	-1.63	4.05**	0.92
Fresh vs microwave	4.11**	1.41	0.12	0.40	3.23**	0.24
Fresh vs cooked frozen	1.28	1.45	0.64	0.06	4.30**	0.03
Room vs refrigerator	2.08	1.60	1.02	-1.36	1.32	0.95
Room vs. microwave	4.73**	2.34*	2.31*	0.03	0.55	0.35
Room vs cooked frozen	1.89	2.37*	1.59	0.42	1.57	0.12
Refrigerator vs microwave	2.69*	0.70	1.32	1.40	0.73	1.30
Refrigerator vs cooked frozen	0.19	0.75	0.57	1.79	0.26	1.07
Microwave vs cooked frozen	-2.88**	0.05	-0.76	0.39	0.98	-0.23

*(P < .05).

**(P < .01).

Table 3. t-values for Shear and Cooking Loss of Roast and Steaks

	<i>Shear</i>		<i>Cooking Loss</i>	
	<i>Roasts</i>	<i>Steaks</i>	<i>Roasts</i>	<i>Steaks</i>
Fresh vs room	3.34**	1.50	0.08	-3.03**
Fresh vs refrigerator	2.79*	2.66*	-1.50	-5.37**
Fresh vs microwave	-0.63	3.28**	-9.57**	-2.07
Fresh vs cooked frozen	1.92	1.54	-0.94	-6.75**
Room vs refrigerator	-0.56	4.70**	-1.45	-2.65**
Room vs microwave	-3.93**	5.42**	-9.59**	1.09
Room vs cooked frozen	-1.43	3.45**	0.87	-4.21**
Refrigerator vs microwave	3.39**	-0.70	-8.17**	3.74**
Refrigerator vs cooked frozen	0.87	1.26	0.58	-1.56
Microwave vs cooked frozen	2.53*	1.97	8.74**	-5.31**

*(P < .05).

**(P < .01).

Table 4 shows the means and t-values of all possible treatments. There was a significant ($P < .01$) difference between the room and cooked frozen roasts. A significant ($P < .05$) difference was observed when comparing the roasts thawed in the refrigerator with those cooked frozen. Lower mean log counts were observed for the microwave-thawed roasts than for the refrigerator-thawed roasts. The difference was not significant and might have been due to the slow growth of microorganisms during

the refrigerator thawing process rather than to destruction by microwaves. The frozen roasts had the lowest log counts. These data support the recommendation that meat should be thawed in the refrigerator.

Table 4. Means and t-values of Microbial Log Counts for Treatment Combinations

	$\bar{x}$	<i>t-values</i>
Fresh vs room	7.0 vs 5.1	5.02**
Fresh vs refrigerator	7.0 vs 4.9	5.50**
Fresh vs microwave	7.0 vs 4.6	6.14**
Fresh vs cooked frozen	7.0 vs 4.2	7.30**
Room vs refrigerator	5.1 vs 4.9	0.65
Room vs microwave	5.1 vs 4.6	1.53
Room vs cooked frozen	5.1 vs 4.2	3.10**
Refrigerator vs microwave	4.9 vs 4.6	0.89
Refrigerator vs cooked frozen	4.9 vs 4.2	2.46
Microwave vs cooked frozen	4.6 vs 4.2	1.57

**($P < .01$).

MICROWAVE VS CONVENTIONAL COOKERY OF BEEF CUTS

W. G. Moody, David Johnston and Carola Bedau

Microwave cooking has generally been found to produce less tender, juicy and flavorful product than conventionally cooked meat. In some studies heat penetration was noticeably uneven in beef and beef-soy loaves cooked in a microwave oven with the corners of the loaves being overcooked, dry and hard. Although cooking time is reduced by microwave cookery, there are increased cooking and volatile losses and a decrease in moisture and thiamine retention. In general, there has been a greater cooking and evaporation loss in beef loaves cooked electronically compared to conventional cookery methods.

Tenderness is another factor affected by cookery methods. Most of the results in the literature report higher tenderness scores for conventionally-cooked chops and steaks than those cooked by microwave. Microwave ovens have been criticized for having hot and cold spots resulting in uneven heat penetration. Other complications can also occur. These include reflection and refraction of microwaves at the interfaces between different food components and the influence of the spatial arrangements of regions with high and low dielectric constants. As a result, meat on the bone requires different handling than a boned-out cut.

Besides affecting the tenderness, juiciness and flavor, microwave cooking also affects the collagen content of meat. Some workers have reported a lower collagen content for microwave cooked meat.

There is a growing interest in alternative methods of meat cookery due to high energy costs and a shortage of preparation time on the part of the homemaker. These latter two considerations must be weighed in the balance when considering microwave cookery. The present study was initiated to compare beef quality characteristics of roasts and steaks from different types of cattle cooked conventionally and electronically.

Steaks and roasts used in this study originated from the cattle studies previously described in the first and second paper by Johnston *et al.*

The steaks in the first experiment were divided into 2 groups and cooked by conventional and microwave cookery. Those cooked by the conventional method were placed in a 162.8°C prewarmed oven and cooked to an internal temperature of 67.8°C. The other half of the steaks was cooked in a Hotpoint microwave cooking center oven to the same internal temperature. The broil unit in the microwave oven was set at 205°C and left on until the meat surface color and browning effect resembled that of the meat from the conventional oven. The procedure usually took from 5 to 6 minutes.

In the second experiment, both roasts and steaks were used. The conventional cookery for the steaks was similar to that described in the first experiment. The roasts were cooked at 65°C, held out of the meat juices for 5 seconds and weighed to the nearest gram. The roasting pans were weighed before and after cooking to determine the amount of drip and evaporative loss. Only total weight loss was determined for the steaks. After determining the cooked weight, 2.54 cm cores were taken from the *longissimus* for each roast along with duplicate samples for the taste panel. The cores were sheared twice on a universal instron instrument for tenderness determinations.

Two Amana Radaranges were used to do the microwave cooking in the second experiment. Total cooking time for the roast was figured by allowing 8 minutes per pound of meat. Steaks were cooked approximately 2 1/2 minutes on each side. As soon as the internal temperature reached 29°C the oven was turned off and the roasts were allowed to equilibrate in the oven until one half hour before the

taste panel. At the end of the resting period, the temperature was found to be between 62.8 and 65.6°C depending somewhat on the degree of muscling and the geometry of the roasts.

The taste panel scores and shear values between the conventional and microwave cookery methods for the different Angus cattle are shown in table 1. In general, there was no difference in these values when comparing steers and heifers when the meat was cooked conventionally. However, when prepared with the microwave oven the *longissimus* muscle from the straight Angus steers was significantly ($P < .05$) less tender and juicy than that from the heifers. Otherwise, there was no major difference between and among traits tested.

Table 2 gives a comparison of the panel variables together with shear scores shown in table 1. Here the cattle were fed grain and grain on grass. Although the difference in juiciness between the grain vs the grain on grass cattle was slight, the method of cookery appeared to influence it. For example, the *longissimus* from the grain fed cattle was more tender when cooked by the conventional method but less tender when cooked in the microwave oven. In fact, the meat cooked in this manner was inferior in all the variables tested except flavor.

Table 1. Mean Taste Panel Scores for *Longissimus* Muscle From Angus and Angus-Cross Cattle Cooked by Two Methods

	<u>Straight Angus</u>		<u>3/4 Angus 1/4 Hereford</u>		<u>1/2 Angus 1/4 Hereford 1/4 Holstein</u>	
	<i>Heifer</i>	<i>Steer</i>	<i>Heifer</i>	<i>Steer</i>	<i>Heifer</i>	<i>Steer</i>
<u>Cookery methods:</u>						
<u>Conventional</u>						
Tenderness	7.3	7.3	7.5	7.5	7.1	7.7
Flavor	7.2	7.2	7.3	7.2	7.3	7.3
Juiciness	7.1	7.0	7.1	7.1	7.1	7.1
O. satisfaction	7.1	7.1	6.9	7.2	7.1	7.2
Shear	6.9	7.2	6.6	6.7	6.9	6.0
<u>Microwave</u>						
Tenderness	7.7	7.4*	7.5	7.5	7.4	7.9
Flavor	7.3	7.0	7.2	7.3	7.3	7.3
Juiciness	7.2	6.8*	7.0	7.1	7.1	7.3
O. satisfaction	7.2	7.1	7.2	7.1	7.1	7.3
Shear	6.7	7.1	6.9	6.6	7.0	6.1

*($P < .05$) means within columns differ significantly.

Table 3 shows the comparison of the above mentioned methods of cookery between Angus and Simmental cross cattle. In this table there appeared to be no significant differences due to breed or method of cookery on flavor, juiciness, tenderness, overall satisfaction and shear.

Table 2. Mean Taste Panel Scores for *Longissimus* Muscle from 2 Beef Feeding Treatment Groups

	<i>Grain fed</i>	<i>Grain on grass</i>
<u>Cookery method:</u>		
<u>Conventional</u>		
Tenderness	7.5	7.4
Flavor	7.2	7.3
Juiciness	7.2**	7.0
O. satisfaction	7.2	7.0
Shear	6.8	6.6
<u>Microwave</u>		
Tenderness	7.4**	7.7
Flavor	7.2	7.3
Juiciness	6.9**	7.2
O. satisfaction	7.0**	7.3
Shear	7.3**	6.2

*(P < .05).

** (P < .01).

The effects of time on the mean sensory and shear values for both the roasts and steaks grouped by conventional and microwave cooking can be seen in table 4. The mean 5-month values for roasts cooked conventionally for the 5 variables measured were consistently higher than the values obtained for roasts in the microwave ovens. Microwave cooked steaks had a slightly higher mean value than conventionally broiled steaks, but otherwise the results were consistent with those obtained for the roasts. At 10 months the results were not quite as clear. This time, the microwave cooked roasts were rated higher in flavor, juiciness and overall satisfaction but once gain lower in tenderness.

Table 3. Effect of Breed on Sensory and Shear Values of Beef Cuts Cooking by 2 Methods

	<i>Conventional</i>		<i>Microwave</i>	
	<i>Roasts</i>	<i>Steaks</i>	<i>Roasts</i>	<i>Steaks</i>
<u>Straight</u>				
<u>Angus</u>				
Flavor ^a	6.8	6.9	6.8	6.9
Juiciness	6.5	6.8	6.0	6.7
Tenderness	7.4	7.1	6.7	6.8
O. satisfaction	6.7	6.8	6.2	6.5
Shear ^b	8.2	8.6	9.5	9.6
<u>Simmental x</u>				
Flavor ^a	6.8	6.9	6.7	6.8
Juiciness	6.4	6.7	6.5	6.8
Tenderness	7.2	7.1	6.8	7.0
O. satisfaction	6.4	6.7	6.3	6.6
Shear ^b	8.4	9.0	8.5	9.8

^aHedonic scale, 1-9: 1 = dislike extremely, 2 = like extremely

^b = (kg) 12.54 cm.

Table 4. Effect of Storage Time on Sensory and Shear Values of Beef Cuts Cooked by Two Methods

	<i>Conventional</i>		<i>Microwave</i>	
	<i>Roasts</i>	<i>Steaks</i>	<i>Roasts</i>	<i>Steaks</i>
<u>Storage time^a</u>				
<u>5 months</u>				
Flavor	6.9	7.0	6.8	7.0
Juiciness	6.7	6.8	6.0	6.6
Tenderness	7.5	7.1	6.7	6.9
O. satisfaction	6.8	6.8	9.2	9.9
Shear	8.2	9.1	6.2	6.6
<u>10 months</u>				
Flavor	6.5	6.7	6.7	6.6
Juiciness	6.3	6.9	6.5	7.0
Tenderness	7.1	7.0	6.9	7.0
O. satisfaction	6.2	6.5	6.4	6.5
Shear	8.1	8.4	8.8	9.2

^aStored at -29C.

CARCASS CHARACTERISTICS AND COMPOSITION AND CONSUMER ACCEPTANCE OF BABY AND LIMITED GRAIN FINISHED STEERS

D. L. Abner, J. D. Fox and Neil Bradley

Over 60 percent of the world's agricultural land is suitable only for forage production. Beef cattle provide a means of converting this otherwise wasted form of energy into a form acceptable for human use. An important question is how to produce acceptable beef from available resources. Baby beef and limited grain fed beef are 2 possible alternatives.

Twelve Angus and 12 Simmental steers were randomly selected from a total of 72 steers and assigned to one of the following finishing systems: weaned at 8 months and slaughtered immediately (Gp.1); weaned at 8 months, overwintered and grazed on roughage and grass-clover pasture for 7 1/2 months, fed 509 kg. of corn per animal over a 2-month period and then slaughtered (Gp 2); weaned at 8 months, overwintered and grazed on roughage and grass-clover and alfalfa pasture for 9 1/2 months, fed 509 kg of corn per animal over a 2-month period and then slaughtered (Gp. 3). Animals were slaughtered at a cooperating slaughter plant and the usual carcass data collected. After aging for 7 days, loin steaks, top round steaks and bottom round roasts were cut, frozen and finally evaluated by a 24 family consumer panel.

Carcass characteristics of the animals by group and breed are given in table 1. As would be expected, carcass characteristics changed with increasing age with only the color of the lean being not significantly different between age groups. There was a slight decrease in marbling score and grade from group 2 to group 3 because of poor pasture conditions during July and August and consequent slow rate of gain during this period. The Simmental cross steers produced larger carcasses than the Angus steers but the Angus steers scored higher in conformation and grade.

Composition of meat from the steers is given in table 2. In general, the younger animals were higher in moisture and lower in fat than the older animals. Because of the loss of moisture during cooking, the protein and fat content was higher in cooked meat than in raw meat. There was little difference in composition between Angus and Simmental cross steers.

Results of consumer evaluation and acceptance of meat by group and breed are given in tables 3 and 4. In general, there were few significant differences in acceptability of meat from the 3 groups or between breeds although groups 2 and 3 scored somewhat higher than group 1. Most of the meat scored average or equal to meat usually purchased but no direct comparisons between experimental and grain fed animals were made at the time the meat was evaluated. Approximately 15 percent of the cuts from groups 1 and 3 would not have been purchased from the grocery store while only 6 percent of group 2 would not have been purchased.

Results of this study indicate that acceptable beef can be produced primarily on roughage with only a limited amount of grain being fed to the animals. With additional information and refinements in the production phase, beef having the grade and quality of choice grain fed beef could be produced primarily on roughage.

Table 1. Means of Carcass Variables

	<i>Experimental groups^a</i>			<i>Breed^b</i>	
	<i>1</i>	<i>2</i>	<i>3</i>	<i>An</i>	<i>Sx</i>
Slaughter wt. (kg)	256.42 ⁿ	445.72 ^o	472.65 ^p	365.76 ^y	417.41 ^z
Carcass wt. (kg)	143.58 ⁿ	249.04 ^o	276.67 ^p	209.99 ^y	236.20 ^z
Maturity score ^c	15.00 ⁿ	14.67 ^o	14.33 ^p	14.72	14.61
Fat color ^d	2.00 ⁿ	2.67 ^o	2.33 ^p	2.17 ^y	2.50 ^z
Lean color ^e	3.29	3.21	3.17	3.11 ^y	3.33 ^z
Marbling score ^f	1.00 ⁿ	3.38 ^o	3.00 ^p	2.56	2.36
Fat thickness (cm)	.30 ^y	.51 ^z	.56 ^z	.51 ^y	.28 ^z
Ribeye area (cm ²)	59.10 ⁿ	65.10 ^o	73.61 ^p	66.00	65.93
Percent kidney fat	1.81 ^y	1.27 ^z	1.38 ^z	1.57	1.40
Grade ^g	6.92 ^y	9.33 ^z	8.79 ^z	8.67 ^y	8.03 ^z
Conformation ^g	10.79 ^y	11.46 ^y	12.50 ^z	12.44 ^y	10.72 ^z
Armour tenderometer	14.01 ^y	16.70 ^z	16.54 ^z	15.92	15.58

^aGroup 1 = baby beef; Group 2 = 18 month; Group 3 = 20 month.

^bAn = Angus; Sx = Simmental crossbred.

^c15 = A-maturity; 14 = A maturity.

^d1 = white; 5 = lemon yellow.

^e1 = pale red; 5 = dark red.

^f1 = devoid; 2 = practically devoid; 3 = traces; 4 = slight; 5 = small.

^g6-8 = low, average, top standard, respectively;

9-11 = low, average, top good, respectively;

12-14 = low, average, top choice, respectively.

^{n,o,p}Means with different letters are significantly different ($P < .05$).

^{y,z}Means with different letters are significantly different ($P < .01$).

Table 2. Composition of Meat

	<i>Experimental group^a</i>			<i>Breed^b</i>	
	1	2	3	An	Sx
Raw muscle:					
<i>Longissimus</i>					
Moisture (%)	75.48 ^y	73.91 ^z	73.99 ^z	74.53	74.39
Crude protein (%)	21.72	21.86	21.54	21.39 ^y	22.02 ^z
Fat (%)	1.28 ⁿ	2.37 ^o	2.89 ^p	2.36	2.01
<i>Semimembranosus</i>					
Moisture (%)	75.75 ⁿ	74.02 ^o	74.72 ^p	75.08 ⁿ	74.58 ^o
Crude protein (%)	21.68	22.01	21.96	21.70	22.07
Fat (%)	.99 ^y	1.68 ^z	1.63 ^z	1.43	1.44
<i>Semitendinosus</i>					
Moisture (%)	75.96 ⁿ	74.77 ^o	75.34 ^p	75.61 ⁿ	75.10 ^o
Crude protein (%)	21.32	21.81	21.46	21.34 ⁿ	21.72 ^o
Fat (%)	1.32 ⁿ	1.71 ^o	1.60 ^o	1.50	
Cooked muscle:					
<i>Longissimus</i>					
Moisture (%)	62.91 ⁿ	64.88 ^o	64.26 ^o	63.92	64.12
Crude protein (%)	31.98 ^y	29.58 ^z	29.18 ^z	30.05	30.44
Fat (%)	2.74	3.23	3.84	3.48	3.06
<i>Semimembranosus</i>					
Moisture (%)	66.10 ⁿ	64.35 ^o	63.46 ^p	64.61	64.66
Crude protein (%)	28.86 ⁿ	29.05 ⁿ	29.67 ^o	29.01	29.37
Fat (%)	3.04	3.64	3.79	3.60	3.38
<i>Semitendinosus</i>					
Moisture (%)	66.72 ^y	64.91 ^z	64.35 ^z	65.36	65.30
Crude protein (%)	28.69 ⁿ	28.92 ⁿ	29.68 ^o	29.02	29.17
Fat (%)	2.85 ^y	4.14 ^z	4.16 ^z	3.57	3.86

^aGroup 1 = baby beef; Group 2 = 18 month; Group 3 = 20 month.

^bAn = Angus; Sx = Simmental cross.

^{n,o,p}Means with different letters are significantly different ($P < .05$).

^{y,z}Means with different letters are significantly different ($P < .01$).

Table 3. Means of Consumer Taste Panel Variables Over All Cuts

	<i>Experimental group^a</i>			<i>Breed^b</i>	
	1	2	3	An	Sx
Size of cut ^c	2.23 ⁿ	2.02 ^o	1.95 ^p	2.08	2.05
Marbling ^d	2.25 ⁿ	2.12 ^o	2.13 ^o	2.12 ⁿ	2.21 ^o
External fat ^d	2.22 ^y	2.07 ^z	2.05 ^z	2.06 ⁿ	2.17 ^o
Appearance ^e	1.21	1.18	1.18	1.18	1.20
Tenderness ^f	1.86	2.06	1.95	1.99	1.92
Juiciness ^f	2.17	2.14	2.04	2.10	2.12
Flavor ^f	2.08	2.00	1.93	2.03	1.98

^aGroup 1 = baby beef; Group 2 = 18 month; Group 3 = 20 month.

^bAn = Angus; Sx = Simmental cross.

^c1 = too big; 2 = average; 3 = too small.

^d1 = too much; 2 = average; 3 = too little.

^e1 = would buy; 2 = would not buy.

^f1 = better than average; 2 = average; 3 = worse than average; 4 = extremely poor.

^{n,o,p}Means with different letters are significantly different ($P < .05$).

^{y,z}Means with different letters are significantly different ($P < .01$).

Table 4. Percentages of Reasons Why Consumers Would Not Have Purchased Cut Based on Raw Appearance

	<i>Experimental group^a</i>			<i>Breed^b</i>	
	1	2	3	An	Sx
Top round steak:					
Lean too dark	0	2.1	0	2.1	0
Too little fat	8.3	4.2	12.5	10.4	14.6
Too much fat	0	0	2.1	2.1	0
Yellow fat	0	0	0	0	0
Too small	5.2	0	0	3.1	2.1
Too big	2.1	0	0	2.1	0
Total	15.6	6.3	14.6	19.8	16.7

EFFECTS OF POST-MORTEM AGING AND COOKING TEMPERATURE
AND RATE ON SELECTED TENDERNESS RELATED CHARACTERISTICS
OF BOVINE MUSCLE

A. S. Alexander and J. D. Fox

Beef is the most widely consumed meat in the United States. Tenderness of beef is not only one of the most important properties of beef to the consumer, but also one of the most variable properties of the muscle. The two basic meat components that influence tenderness are connective tissue proteins and myofibrillar or contractile proteins. The relative contributions of the two major tenderness components can be determined by using adhesion measurements (which estimate the strength of connective tissue holding muscles together), tensile strength and shear force values (which measure general meat tenderness or toughness), and sarcomere length measurements (which are related to myofibrillar toughness).

A two-phase research project was undertaken to determine the effect of post-mortem aging and cooking upon selected sensory, mechanical, chemical and histological tenderness-related characteristics of beef.

Twenty-four round muscles were obtained from 12 choice grade steers and aged for 0, 1, 5 and 10 days post-mortem to determine the effect of aging on tenderness of beef. Results of the research indicate that as post-mortem aging increased from 0 to 10 days, sensory tenderness scores increased and residual connective tissue scores and shear force values decreased. These data support the accepted position that meat becomes more tender with aging.

It is commonly known that cooking affects the tenderness of meat. However, little research has been published on the exact changes that take place when meat is heated. In order to study the effects of heating, round and loin muscles were aged for 5 days and small portions removed to determine the changes that occur when muscle is heated from 50°C to 90°C. It was found that as the cooking temperature of the meat increased, the toughness of both the connective tissue (as measured by adhesion value) and myofibrillar proteins (as measured by fiber tensile strength) increased significantly. The greatest changes in tensile strength occurred between 50°C and 80°C. However, changes in adhesion were linear through 90°C. These results indicate that cooking meat to high temperature results in tougher meat.

In order to determine why tensile strength values increased, sarcomere lengths were measured to determine if muscle contracted during cooking. Results show that as muscle is heated, sarcomere lengths decreased indicating that muscle contraction is the cause of increased tensile strength and thus tougher meat.

Scanning electron observations of the aged and cooked muscle indicates that both aging and increased cooking temperature resulted in decreased ultrastructure integrity of the muscle with longer cooking times intensifying such effects. This could explain why muscle becomes more tender with aging but does not explain the increased adhesion values obtained with increased heating of the muscle.

Extension publications relating to beef production in Kentucky are available at your County Extension Office. See him for a copy!

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Breeds of Meat Animals
Parts of Meat Animals
Cuts of Meat Animals
Giving Oral Reasons

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