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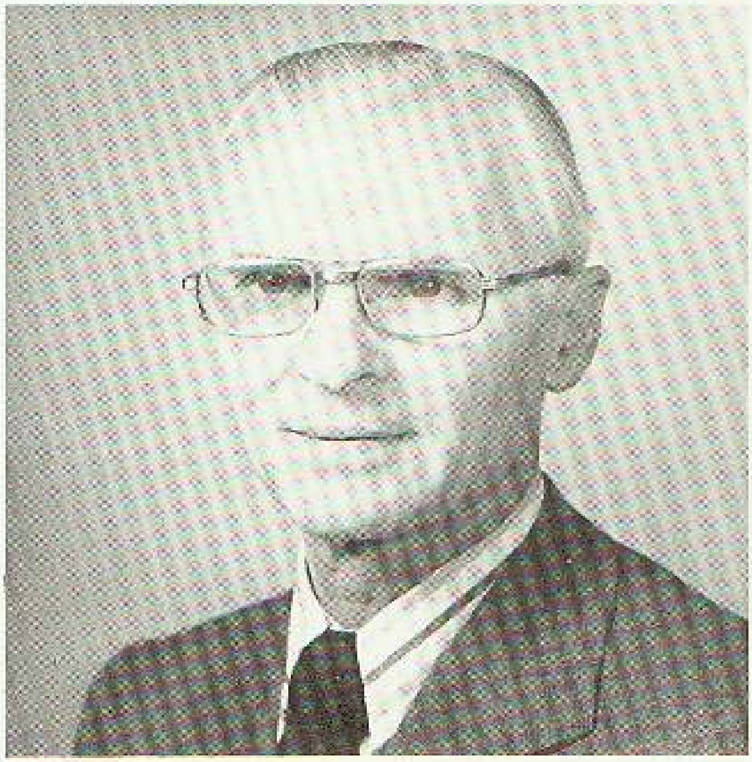

Draytford (Drake) Richardson joined the Kansas State College Animal Husbandry Department in 1951, after completing M. S. and Ph. D. degrees at Iowa State University. He was born in 1917 on a tobacco and livestock farm in Gresham, South Carolina, and graduated from Clemson in 1938. He served on Clemson's extension and teaching staff, and as an infantry officer during World War II.

Dr. Richardson was heavily involved in beef cattle studies. He was one of the leaders in research on antibiotics in beef cattle rations. He also worked on ratio of roughage to concentrate in finishing rations, non-protein nitrogen (urea) use, utilization of sorghum grain and roughage, silage quality, and phosphorus metabolism. He was one of the pioneers in studying the Vitamin B_{12} needs of swine.

The Richardsons are heavily committed to international agriculture. From 1968 to 1970, Dr. Richardson was Chief of Party with the Kansas State University AID (Agency for International Development) project at Andhra Pradesh Agricultural University, in Hyderabad, India.

He has served on a number of university committees, and is a member of numerous professional societies. In 1979, he was named Honorary Fellow of the American Society of Animal Science at the Society's annual meeting at Tuscon. He served on the publications committee for the annual Cattlemen's Day for 20 years and, from 1970 to his retirement, served as Coordinator of Research for the Animal Sciences Department.

Drake and his wife Edna have three sons, David, Ralph, and Daniel. Drake retired December 31, 1979. We wish the Richardsons a long and happy retirement.

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Biological Variability and Chances of Error

The variability among individual animals in an experiment leads to problems in interpreting the results. Although the cattle on treatment X may have had a larger average daily gain than those on treatment Y, variability within treatments may mean that the difference was not the result of the treatment alone. Statistical analysis lets researchers calculate the probability that such differences were from chance rather than treatment.

In some of the articles that follow, you will see the notation "P<.05." That means the probability of the differences resulting from chance is less than 5%. If two averages are said to be "significantly different," the probability is less than 5% that the difference is from chance--the probability exceeds 95% that the difference results from the treatment.

Some papers will report a correlation between two traits. Correlations are a measure of the relationship between traits. The relationship may be positive (both traits tend to get bigger or small together) or negative (as one trait gets bigger, the other gets smaller). A perfect correlation is one (+1 or -1). If there is no relationship, the correlation is zero.

In other papers, you may see a mean given as 2.50±.10. The 2.50 is the mean; .10 is the "standard error." The standard error is calculated to be 68% certain that the real mean (with unlimited number of animals) would fall within one standard error from the mean, in this case between 2.40 and 2.60 (2.50-.10 = 2.40 and 2.50+.10 = 2.60).

Many animals per treatment, replicating treatments several times, and using uniform animals increases the probability of showing the real differences resulting from treatments. The statistical analysis allows more valid interpretation of the results regardless of the number of animals. In nearly all the research reported here, statistical analyses are included to increase the confidence you can place in the results.

KSU

Hot Processing--Potential for Application in the Beef Processing Industry

Summary

Three studies were conducted to evaluate the economics and quality of hot-processed beef. Study I compared two hot-processing techniques to conventional chilling and processing to determine efficiencies of energy, labor, and other resources. Substantial savings occurring with hot-processing techniques include: 32 to 42% less energy need, significantly less cooler space requirement, eliminating the need to shroud carcasses, less labor, and reduced carcass shrinkage resulting in savings of $2.36 to $2.75 per head slaughtered. Study II compared the color and eating qualities of electrically stimulated and hot-processed beef with conventionally processed beef. Electrically stimulated and hot-boned loineye steaks were similar or superior to conventionally treated counterparts for shear force, taste panel, and color characteristics. However, electrically stimulated and hot boned inside round steaks were less tender (though still acceptable) than conventionally processed steaks. Color was similar for all treatments. Study III compared microbial aspects of hot-processed with conventionally processed beef, in an attempt to establish minimum chilling rates required to produce an acceptable hot-processed product. Beef that is hot processed 1 hr postmortem and vacuum packaged must be chilled to 21 C within 9 hr and then chilled to 2 C to be microbially acceptable. This is the minimum acceptable chilling rate, but more rapid chilling would be more desirable from a microbiological standpoint provided it does not toughen the product by such changes as cold shortening.

Introduction

Current beef processing technology involves animal slaughter, carcass chilling, then carcass fabrication. An alternate process, called hot boning or hot processing, is gaining increased interest because of its potential economies. Hot processing is the removal of muscle from the carcass before conventional chilling. Therefore, excess fat and bone are not chilled.

However, beef muscle removed from the carcass and chilled or frozen before rigor mortis can toughen due to cold shortening, thaw rigor, and because muscles are not restrained from contracting by the skeleton. Prerigor muscle can freely contract unless restrained. Cold shortening is cold-induced shortening resulting in toughening of prerigor muscle. Thaw rigor is toughening when muscle frozen prerigor is thawed. Because of these toughening effects, careful processing techniques must be utilized to insure successful hot processing of beef steak and roast items.

Two approaches have been successful in producing quality products.

Carcasses have been hot processed 1 to 2 hr postmortem, and muscles and muscle systems vacuum packaged 24 to 48 hours at 15 C or aged 8 days at 1 C. Alternatively, carcasses were held at 15 to 16 C for 5 to 8 hours postmortem, then processed. Both techniques generally produce equal or superior product compared to conventionally processed counterparts in terms of eating quality, yield, color, and microbial acceptability.

Application of an electrical stimulus to the carcass soon after slaughter can significantly speed the onset of rigor mortis. Therefore, electrical stimulation may facilitate hot processing by eliminating or reducing the need for carcass or muscle conditioning or aging as previously discussed. Consequently, electrical stimulation may allow hot-processing techniques that coincide more closely with current industry practices than do carcass or muscle conditioning.

Economic and quality studies have been conducted at Kansas State University to determine if hot processing compares favorably with conventional processing. The following studies evaluated 1) the economics of hot processing, 2) the eating characteristics of hot vs. conventionally processed beef, and 3) the microbial characteristics of hot-processed beef.

Beef Display Color

Color of beef cuts in retail store display has an important influence on which cuts the buyer chooses.

Customers have "learned" that a bright cherry red meat color assures good meat. They are turned off by dark red or brownish discoloration, even though such products may still have acceptable eating characteristics. Discoloration results from too long a time in display, poor sanitation, a too warm display case, improper lighting and is also influenced by feeding and pre-display processing.

We study color stability by packaging beef muscles in packages like those used for retailing, and displaying them under controlled lighting and temperature. Color is scored visually by experienced observers and by electronic reflectance measurements before display begins and after various display periods.

Retailers estimate that color changes cause 3 to 5% of all retail beef cuts to become unsaleable, be trimmed and repackaged, or the price discounted. Therefore, we need to know if animal or carcass treatments degrade appearance of beef cuts under conditions in which most beef products are sold.

Study I: Economic Feasibility of Hot Processing Beef Carcasses

J. McCoy, P. Nason, D. Chung, C. Kastner,
A. Lawrence, M. Dikeman, M. Hunt, and D. Kropf

Nearly all steer and heifer beef carcasses processed in the United States are chilled before cutting. However, recent meat science research has shown that carcasses can be processed, and quality of meat maintained, with little or no chilling. Processing as defined here involves cutting the carcasses into subprimal pieces, removing bones and excess fat, sealing the pieces in vacuum packages, and placing the packages in palletized boxes. It is already known that substantial economic saving can be obtained from reduced storage and transportation costs of boxed beef, but little work has been done on the economic feasibility of hot processing.

This study compared two hot carcass processing techniques with conventional cold processing to determine comparative efficiency in use of energy, labor, and other resources. Hot processing option I includes an 8-hour conditioning period before cutting, which compares with 72 hours chilling in the conventional cold process. Hot processing option II eliminates the conditioning period, but includes electrical stimulation of the hot carcasses immediately before cutting.

Our analysis was based on a plant designed to slaughter 480 head of cattle a day during an 8-hour shift. No attempt was made to quantify, or evaluate, total resource use for each option. Instead, the objective was to determine differences in resources used.

Hot option I would require about 64 fewer Btu per pound of finished product than cold processing, a 42% reduction. The hot option II reduction would be 50 Btu per pound of finished product, a 32% reduction. Omitting the shroud load from both hot-processing options provided a major saving, as did not cooling the bones and fat trim. Additional energy savings were found in external building transmission, electrical equipment load, and lighting load. At 1979 electric rates, total energy savings amounted to 26 cents and 34 cents per carcass for hot options I and II, respectively.

Eliminating shrouds, shroud pins, and neck pins gave a 3 cent per carcass saving.

No attempt was made in our study to quantify labor time savings, but Armour Food Company and USDA showed reduced labor requirements for hot processing. The Armour study[1] indicated labor savings which at 1979 labor rates would convert to approximately $47.20 per hour for the entire slaugh-

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[1] Armour and Co. 1977. Personal communications on 1967 test study.

tering and processing crew. A more recent USDA study[2] found labor savings of 13 minutes per carcass for the cutting operation only. At 1979 labor rates that would amount to $1.68 per carcass for hot option I, and $1.67 for hot option II--the difference due to maintaining an electrical stimulator in hot option II.

Since cooler capacity requirements are substantially less for hot processing--capital for cooler requirements, at 1979 costs, would be reduced by $325,000 for hot option I and by $677,000 for hot option II. No shrouding platform ($1,089) is needed for hot processing. The only additional capital cost would be an electrical stimulator ($21,000) for hot option II. At 10.5%, interest savings per carcass processed would be approximately 24 and 49 cents for hot options I and II, respectively.

In hot option II, the meat would move through the system in about 24 hours less time than in cold processing. That means reduced working capital requirement of the value of one day's output. The reduction in working capital for hot option I is approximately two-thirds that of hot option II. At 1979 wholesale beef values, the monetary savings in working capital at an interest rate of 10.5% would be 14 and 21 cents per carcass for hot options I and II, respectively.

The combined saving from all elements for hot option I is $2.36 per carcass, or $329,236 on an annual basis. For hot option II, the combined saving is $2.75 per carcass, or $383,253 annually.

Preliminary evidence indicates additional possible savings from reduced meat shrinkage, but more work is needed to quantify that item.

Warner-Bratzler Shear
and Meat Tenderness

In 1932, K. F. Warner and L. J. Bratzler of the Animal Husbandry Department at Kansas State College developed a mechanical method for measuring meat tenderness. Cores from cooked steaks or roasts are placed in the apparatus and the pounds of force required to "shear" the core are recorded. Because Warner-Bratzler shear values correlate well with taste panel measurements of tenderness, this technique is used in many countries as an "unbiased" test of tenderness. The Warner-Bratzler apparatus is manufactured by G-R Electric Mfg. Co. of Manhattan.

[2]USDA. (Undated). Optional Methods for Hot Processing Beef Carcasses. Progress Report for Packerland International Inc. Meat Science Research Laboratory. S.E.A. Beltsville, Maryland.

Study II: Electrically Stimulated and Hot-Processed Beef--Color and Eating Qualities

K. Nagele, M. Dikeman, M. Hunt, C. Kastner, D. Kropf, M. Lyon

Introduction

Hot processing is gaining increased interest in the beef processing industry today because of the previously mentioned processing efficiencies and economic advantages. This study examined the color and eating characteristics of electrically stimulated hot-processed beef compared with beef conventionally chilled and processed.

Procedure

One side of each of 46 carcasses was electrically stimulated continuously for 2 minutes with 400 to 600 volts and 5 amps of AC (60 Hz) current at 1 hr postmortem. The Longissimus (loineye) and Semimembranosus (inside round) muscles were hot boned at 2 hr postmortem and vacuum aged 7 days at 2.2 C (36 F) before steaks were removed. Conventionally treated carcass halves were chilled at 2.2 C, then loineye and inside round steaks were removed 7 days postmortem. A trained taste panel scored steaks for palatability, and half-inch diameter cores were sheared with a Warner-Bratzler shear. Steaks for display were packaged in oxygen permeable film, placed under display lighting for 5 days at 2 C, and color was evaluated by four panelists.

Results

Means for taste panel and shear force are shown in table 1.1. Loineye steaks had similar values for tenderness, flavor, and shear force from electrically stimulated hot-processed and conventionally processed carcasses. But, shear force and taste panel data indicated that electrically stimulated inside round steaks were less tender than conventionally processed round steaks, although taste panel scores for both groups were in an acceptable range. No significant differences in color were found except on the second display day, when electrically stimulated hot-boned loineye steaks were brighter red than their conventionally processed counterparts.

Table 1.1. Taste panel and shear force scores (means) for ESHP[a] and Conv[b] beef loin eye and inside round steaks.

Criteria	Loin eye		Inside round	
	ESHP	Conv	ESHP	Conv
Taste panel traits[c]				
Muscle fiber tenderness	6.4	6.4	5.7	6.1
Detectable connective tissue	7.1	7.0	6.2	6.4
Juiciness	6.6	6.4	5.3	5.3
Flavor	6.3	6.2	6.0	6.1
Shear force (lb)	2.81	2.99	4.13	3.58

[a]ESHP = Electrically stimulated and hot-processed.

[b]Conv = Conventionally processed.

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

Taste Panels

The palatability or eating desirability of meat is the ultimate measure of the success of beef production and processing. Taste panels are used to measure this palatability.

There are basically two types of taste panels. When consumer preferences for meat products are wanted, a "consumer taste panel" is used. A minimum of 100 randomly chosen consumers are asked to evaluate meat samples according to how well they like or dislike the samples. When more precise measurements of tenderness, flavor intensity, and juiciness are wanted, a "trained taste panel" is used. Trained taste panels consist of six to 12 persons that have been trained to consistently and accurately detect differences in various meat samples. In both types of taste panels, the cooking and sampling procedures are strictly controlled, and the identity of samples are coded so that the panelists do not know which samples are being evaluated.

Study III: Hot Processed Beef--Microbiological Characteristics

D. Y. C. Fung, C.-Y. Lee, C. Kastner, M. Dikeman,
M. Hunt, D. Kropf, and M. Lyon

Introduction

To help insure that hot-processed beef has an acceptable shelf life and is microbiologically safe, the microbial characteristics of the product must be evaluated. This is particularly true for hot-processed cuts that are packaged and boxed prior to complete chilling--a practice that facilitates handling. An adequate chilling rate the first several hours postmortem is extremely important to the microbiological quality and shelf life of meat. Therefore, in order to insure an acceptable hot-processed beef product, this study was designed to establish chilling rates necessary to satisfactorily control microbial activity in hot-boned beef.

Procedure

Ten steers were slaughtered at hourly intervals in Experiment I, five in Experiment II, and three were slaughtered within one hour in Experiment III. One side of each carcass was hot processed within 2 hr postmortem, and the other side was conventionally chilled and cut at 48 hr postmortem. Samples from hot-processed and conventionally treated sides were vacuum packaged, boxed, stored, and chilling rates were monitored. Samples taken before and after 14 and 21 days of storage and 3 days of lighted display were examined for microbiological characteristics.

Results

As expected, conventionally treated samples chilled faster than hot-processed counterparts for the first 24 hr of chilling. Hot-processed cuts had higher total microbial counts than conventionally treated samples at each sampling period. However, hot-processed samples were within the generally accepted range, except for extended storage and display periods. Beef hot-processed 1 hr postmortem and vacuum packaged should be chilled to 21 C within 9 hr or less, then rapidly chilled to 2 C to be microbially acceptable. Therefore, this research established minimum chilling rates to produce an acceptable hot-processed beef product and help foster the economically attractive technique of hot-processing. Chilling rates faster than those necessary to achieve 21 C in 9 hr postmortem may be more desirable from a microbial standpoint but should be carefully evaluated, because they may result in a toughened product due to undesirable changes such as cold shortening.

Application and Potential of Electrical Stimulation

Curtis L. Kastner

Background

It has been known for years that electrical stimulation will improve tenderness of meat, but the technique only recently has gained considerable interest in the meat industry.

Benjamin Franklin in 1749 observed that killing turkeys electrically made the muscle quite tender. In 1951, Harsham and Deatherage and Rentschler gained separate patents for tenderizing carcasses with electrical stimulation. Tenderness was the most obvious change stemming from electrical stimulation. However, research efforts in New Zealand, England, and the United States have recently attributed other important results to the technique.

Primary Benefits

Besides improving tenderness, electrical stimulation increases lean firmness and color brightness, speeds marbling development, and facilitates hot boning.

Stimulation Methodology

A variety of different methods have been and are being used to stimulate beef and lamb carcasses for research or for industry applications. Both carcass halves and intact carcasses are stimulated. Normally intact carcasses are used commercially, and the electrical stimulus is administered near the hindshank and neck region. Electrical contact may be achieved by inserting probes in the carcass, or with surface contacts. Voltages have ranged from 40 to 3000 volts, and a variety of amperages, frequencies, on-off pulsing techniques, square versus sine waves, AC versus DC current, and stimulation times have been studied. Stimulation times from 1 to 2 minutes normally are used. The optimum combination of these conditions has not been determined. Even so, electrical stimulation has proved more or less effective with most combinations, and best results have been achieved by stimulating within 1 hour after slaughter. Usually the sooner after slaughter, the more dramatic the effects. Not all muscles are affected equally by carcass stimulation. Some muscles may not be stimulated to the same extent as others or are not as responsive to electrical stimuli. Therefore, results based on only a few muscles may not be indicative of how the total carcass responds. The following results should be evaluated with this in mind.

Primary Causes of Benefits

Electrical stimulation speeds the onset of rigor mortis (carcass stiffening) by rapidly depleting the residual energy in the muscle after slaughter. As a result, the acidity of the muscle is rapidly increased compared with nonstimulated muscles. The ultimate acidity is not increased over that of nonstimulated muscle, but acid accumulates faster. It is thought that the relatively rapid onset of rigor mortis, acid accumulation, and intense muscle contraction during stimulation cause the results attributed to electrical stimulation.

Specific Benefits

Tenderness

Rapid chilling of carcasses after slaughter is used to control microorganisms and prepare carcasses for conventional grading and cutting. However, when muscle is chilled too rapidly before the onset of rigor mortis, muscle may be toughened by a condition called cold shortening. It is not uncommon for normal chilling practices to be sufficiently rapid to cause cold shortening, which occurs most frequently in carcasses with little fat cover.

Electrical stimulation speeds rigor onset so cold shortening effects are minimized or eliminated; thus tenderness is improved. The rapid accumulation of acid in stimulated muscle appears to accelerate the aging process and reduce the aging time needed to insure tenderness. For example, strip loins from electrically stimulated carcasses are as tender after 7 days' aging as nonstimulated strip loins are after 21 days. Additionally, severe contraction during stimulation may physically disrupt the muscle and improve tenderness. Connective tissue may be made more susceptible to breakdown upon heating, and the muscle proteins responsible for rigor mortis may be more loosely bound together after electrical stimulation.

Therefore, these proposed mechanisms of tenderization either singularly or collectively account for a 20 to 30% improvement in beef muscle tenderness when compared with that of nonstimulated muscle. Muscle that is already tender is improved very little, but less tender muscle is significantly tenderized. Consequently, wide variation in tenderness (frequently experienced) is reduced.

Most recent research results have been obtained on beef carcasses; however, the effects of electrical stimulation have also been demonstrated with lamb.

Color and Marbling

Electrical stimulation causes the desirable color of beef muscle to develop more rapidly and be brighter at 48 hours after slaughter compared with nonstimulated muscle. This minimizes the regrading of beef carcasses that may have to be held additional time to allow desirable color development. Rapid color development and increased muscle firmness due to stimu-

lation appear to make muscle marbling more apparent sooner after slaughter, which reduces time required between slaughter and grading.

Color and apparent marbling differences between stimulated and non-stimulated beef muscle may be minimized as the time after slaughter increases (exceeding 48 hours). But a processor who wants to grade beef carcasses before 48 hours may obtain a higher percentage (up to 14 percent in one study) of higher grading carcasses by using electrical stimulation.

Hot Boning

Recent studies here in conjunction with the Departments of Agricultural Economics and Agricultural Engineering showed hot boning beef carcasses to be an economically advantageous process when energy, labor, and other resources are considered. Savings due to hot processing amounted to $2.75 per carcass (energy 34¢, materials and supplies 3¢, labor $1.67, interest on fixed capital 49¢, and interest on inventory 21¢ per head). These savings would contribute significantly to the overall profit picture of processors.

Hot boning, or cutting the carcass before chilling, has proved successful when certain precautions are observed. But, cutting carcasses prior to the onset of rigor mortis can result in a less tender product. So, early successful hot-boning involved holding the carcass 5 to 8 hours postmortem to allow rigor onset before cutting, or aging cuts removed at 1 to 2 hours postmortem for 8 days at refrigeration temperatures or for 24 to 48 hours at 60 F to minimize tenderness problems associated with pre-rigor cutting. Such practices do not necessarily facilitate the continuous flow of product, so electrical stimulation can be used to speed rigor mortis onset and allow carcasses to be hot boned without holding and aging periods.

We are continuing to evaluate electrical stimulation as a complement to hot boning. Our research shows that all beef muscles do not respond equally to our electrical stimulation and hot boning methodology when compared to conventionally treated carcasses. However, none of our samples were rated as unacceptable. We hope to determine the electrical stimulation methods needed to optimize hot-boned beef quality.

Industry Applications and Considerations

An estimated 15,000 beef carcasses are electrically stimulated daily in the United States with products being marketed under various brand names as: Good and Tender, Electro Tenderaged, Trueth Tender, Electrolit, and Electro Tender. Companies like Le Fiell, Britton Manufacturing, Koch, Cervin Manufacturing, and Omeco St. John Company produce commercial stimulators ranging from $10,000 to $40,000 per unit that will handle up to 250 beef carcasses per hour, so the practice likely will increase.

Cost of operation is approximately 0.3 cent per carcass; however, other costs must be considered. Operator labor, cost of the stimulator, sanitation, and space are other cost factors. The units are relatively simple to maintain, and some of the more expensive ones are automated, requiring no operator.

Because of increased industry use of electrical stimulation, USDA has established guidelines to insure employee safety and product wholesomeness. Extreme caution should be used, especially when high voltages and amperages are being used.

Summary

Electrical stimulation offers several potential benefits to the meat processor. The technique can be easily adapted to operations where only a few cattle per day or per week are slaughtered.

With electrical stimulation, the occasional less tender carcass may be avoided, tenderness is more uniform, aging time to insure tenderness may be significantly decreased, and the time between slaughter and grading and cutting can be significantly reduced yet product quality maintained. In addition, electrical stimulation may be used to insure the tenderness of beef from carcasses with little exterior fat cover. Producers may be interested in feeding cattle for shorter periods of time or producing cattle that reach desirable slaughter weights yet have minimum fat cover. Electrical stimulation can be used to maximize product tenderness for beef resulting from these production practices. Therefore, electrical stimulation can give the producer greater latitude in using alternative management systems and cattle types.

Electrical Stimulation of Beef Carcasses

When beef carcasses are electrically stimulated soon after slaughter, the resulting muscle contractions cause some of the chemical energy in the muscle to be used up. Rigor occurs much faster; tenderness, color, firmness, and quality grade are improved; and aging time decreases. Largest improvements are in lower grading carcasses with less fat cover or in carcasses that are "hot boned" without conventional chilling. Nationally, about 15,000 carcasses per day are stimulated, and the practice will probably increase.

Ground Beef from Electrically Stimulated and Pre-rigor Processed Carcasses

M. C. Hunt, J. L. A. Kendall, M. E. Dikeman, C. L. Kastner, and D. H. Kropf

Summary

Ground beef from electrically stimulated and/or pre-rigor processed carcasses was equivalent to conventional ground beef in texture, palatability, and frozen storage stability, but lost more juice when vacuum-stored, had 2% more total cooking losses from patties, and 1 day less shelflife during display.

Introduction

Ground beef constitutes about 50% of all beef consumed, so we investigated effects of the accelerated processing methods of electrical stimulation and pre-rigor processing, which have energy saving potential for steak and roast meats, on ground meats.

Experimental Procedure

Our ground beef samples were removed from the chuck (clod) and shank areas of 46 large- and small-type cattle fed finishing rations 112 to 154 days. Half of the carcass sides were electrically stimulated (2 minutes continuous, AC, 60 Hz, 440 volts, 6 amps) 1 hr postmortem, and all sides except the control group were pre-rigor processed 2 hr postmortem. Fat content of the ground meat was 22 to 24%. We evaluated packages and patties from each treatment for color, palatability, and storage properties. Treatments were:

1: Control, conventional processing (no electrical stimulation)
Trim removed 48 hr postmortem, then ground through ½-inch plate
Vacuum-stored 6 days
Final-grind, 1/8-inch plate

2: Electrically stimulated sides
Trim removed 2 hr postmortem
Vacuum-stored 6 days
Final-grind through 1/2- and 1/8-inch plates

3: No electrical stimulation
Trim removed 2 hr postmortem, then ground through ½-inch plate
Vacuum-stored 6 days
Final-grind, 1/8-inch plate

4: Electrically stimulated sides
Trim removed 2 hr postmortem, then ground through ½-inch plate
Vacuum-stored 6 days
Final-grind, 1/8-inch plate

Results and Discussion

Shear and Taste Panel Traits: Lee-Kramer shear values and scores for cooked patty tenderness, juiciness, flavor, crumbliness, and rubberyness were similar for all treatments. Ground beef textural properties were not adversely affected.

Frozen Storage Stability: Measures of rancidity (thiobarbituric acid method) after 0, 3, 6, 9, and 12 months' frozen storage were similar for all treatments.

Display Color Stability: Packages of ground beef from the control had the brightest red color scores initially and through 4 days of display. Color stabilities of other treatments were similar, but their color scores were slightly, and consistently, lower than the controls, which had about 1 day longer display life.

Juice Loss in Vacuum Bags: Treatments 2, 3, and 4 had twice as much free juice in vacuum-stored bags of coarse ground meat or trim than the control group. Apparently this juice is squeezed out of pre-rigor meat while it undergoes rigor, but can be re-incorporated into the ground product during the final-grinding process. Electrical stimulation of sides increased free juice accumulation, probably due to a more rapid pH decline.

Total Cooking Losses in Patties: In general, treatments 2, 3, and 4 had about 2% higher cooking losses in both 1/8 and 1/4 pound patties than did control group patties. However, these losses did not lower taste panel scores for juiciness.

Hot Processing of Beef Carcasses

When carcasses are chilled before they are cut up, considerable refrigeration energy is used to cool the bone and excess fat. Processing carcasses before chilling reduces the energy required and operating cost by $2.75 per cut carcass. In addition, shrink due to moisture loss is lowered.

Hot processing fits particularly well into boxed beef operations. See the articles on hot processing for further details.

Two Semen-thawing Procedures Compared by Competitively Mating Beef Cows

K. G. Odde, G. H. Kiracofe, H. S. Ward, and John Brethour[1]

Summary

Seventy-five cows were used to compare the fertilizing abilities of sperm packaged in 0.5-ml straws and thawed in warm water to similarly packaged sperm thawed in the inseminating gun. A system of competitive mating provided for inseminating each cow twice. After cows had estrus synchronized, each was artificially inseminated with one straw of Angus semen plus one straw of Simmental semen; semen in one straw was thawed in warm water, the other in the inseminating gun. Calves produced indicated the fertilizing sperm.

Of the 20 cows that conceived at the synchronized estrus, 16 conceived to warm water-thawed semen and 4 to semen thawed in the gun. These data indicate that sperm thawed in warm water before breeding were more capable of fertilization when tested in the same cow against sperm thawed in the inseminating gun.

Introduction

Properly thawing semen is essential for successful artificial insemination, so the best thawing method has been discussed in the artificial breeding industry for years.

Rapid thawing (35 C vs. 5 C water bath) of semen packaged in 0.5-ml straws increases motility and intact sperm cap percentages. However, there is little information on cow fertility with different thawing procedures, so we compared warm water semen thawing and gun thawing.

Experimental Procedure

Seventy-five Angus, Hereford, and Angus x Hereford lactating spring-calving cows were synchronized with Syncro-Mate B[2] (ear implant of 6 mg norgestomet for 9 days, and 3 mg norgestomet and 5 mg estradiol valerate intramuscular at implantation) and inseminated 48 hr after implants were removed.

Each cow was inseminated with two 0.5-ml straws, each containing one-half the normal number of sperm cells.[3] One straw was thawed in 35 C (95 F)

[1] Fort Hays Experiment Station, Hays, KS 67601.

[2] Syncro-Mate B was provided by G. D. Searle Co.

[3] Semen was provided by Curtiss Breeding Service.

water for 20 seconds; the other, in the gun before and during insemination. Each cow was inseminated with one straw of Angus semen and one of Simmental semen, one warm water thawed and one gun thawed. The combination of thaw procedure and breed was alternated to remove any effect from breed or order of inseminating. The color of the calf identified the successful semen and, thus, the successful thawing method.

Clean-up bulls were withheld from the cows 15 days so we could positively identify sire of calf at birth.

Results and Discussion

Sixteen of the 20 cows that conceived after the synchronized estrus conceived to semen thawed in warm water, and 4 to semen thawed in the gun.

When 0.5-ml straws of frozen semen are placed in 35 C water, thawing is complete in approximately 13 seconds. Thawing time in an insemination gun is unknown, but it is much slower. Rapid thawing apparently allows more viable sperm cells to be presented to the uterus and may explain why warm water-thawed semen was 4 times as successful as gun-thawed. Rapid thawing may also improve sperm fertilizing ability and fertilizing lifespan.

Because semen is only one of many variables involved in cow conception, one should not expect a large advantage in conception rate from a warm water thaw over gun thaw. These data indicate that a warm water thaw is a preferable procedure; however, we cannot predict that a higher conception rate will be obtained from warm water thaw if the optimum number of viable sperm are inseminated after gun thaw.

HEAT SYNCHRONIZATION HORMONE APPROVED

On November 11, 1979, a major breakthrough for cattlemen occurred with the official clearance of a new heat synchronization compound. Lutalyse, The Upjohn Company trade name for prostaglandin $F_{2\alpha}$, will offer beef cattle producers the opportunity to take even greater advantage of artificial insemination (AI) because of the potential of reducing labor and management associated with heat detection. Presently, the only system of using Lutalyse recommended on the label is two injections given 11 days apart. Although this is the only system approved efficient by the Food and Drug Administration, other systems such as breeding AI for 5 days then injecting only the cows that have not shown heat may have merit depending on the producers goals. Lutalyse synchronizes heat only in cycling cattle and will not improve conception rates. It is only a management tool that allows you to have cycling cattle in heat at a predicted time.

The cattleman should first appraise the reasons he is attempting to synchronize heat, then weigh the possible benefits he can achieve against the cost of the product and the labor involved. He should also make sure he has the facilities, equipment and ability to AI the numher of cattle he is going to synchronize.

Effect of Early Weaning on Subsequent Reproduction and Calf Production by Replacement Heifers

W. D. Busby, M. McKee, and L. R. Corah

Summary

Analysis of breeding records for 128 percentage Simmental females either weaned early (average age 63 days) or conventionally (average age 194 days) showed no statistically significant difference between early-weaned and nursed heifer calves for subsequent conception rate, calving date, ease of calving, calf birth weight, or 205-day adjusted calf weaning weight.

Introduction

The 205-day weights of early weaned calves and of nursed calves do not differ (1977 and 1978 Cattlemen's Day). No data have been reported on reproduction or calf production by heifer calves weaned early.

Experimental Procedure

Breeding records for 128 percentage Simmental females were analyzed to determine if weaning heifer calves early had any effect on their subsequent reproductive performance or production ability. Fifty-nine of the females had been weaned early (21 to 136 days of age), and 69 had nursed their mothers to an average age of 194 days at weaning. All were maintained in drylot after the birth of first calves. The study involved 5 calf crops (1975 to 1979). During the 5 years, females were equally distributed in various nutrition and breeding studies. Calving-ease scores used were: 1) no assistance, 2) assisted, easy, 3) assisted, difficult, 4) Caesarean delivery, 5) abnormal presentation, and 6) dead at delivery. All calves were weighed at birth, at early weaning (adjusted to 55 days of age) and at normal weaning time (adjusted to 205 days). Each yearly breeding period was approximately 60 days, 35 days AI then 25 days clean-up.

Results and Discussion

Five-year conception rates for females (table 5.1) previously weaned early were similar to those that nursed as calves. No measures of calf production differed significantly (table 5.2). The 205-day adjusted weights reported in table 5.2 are only for calves that nursed their dams for approximately 205 days (39 head from early-weaned dams and 47 head from conventional dams). All other calves were weaned early. Thus, early weaning of heifers had no effect on subsequent reproduction or calf production.

Table 5.1. Effect of suckling on subsequent reproductive performance of replacement heifers.

Item	Early wean	Conventional
No. heifers	59	69
Age at weaning, days	63	194
Conceived as heifers, %	79.7	85.5
No. possible exposure periods*	160	177
Conception rate, % for 5 years	80.0	79.7

*One exposure period = 1 60-day breeding season per cow.

Table 5.2. Effect of suckling treatment on subsequent calf production by replacement heifers.

Item	Treatment of dam	
	Early wean	Conventional
Live calves born	98	95
% death loss in calves		
at birth	5.1	5.3
birth to weaning	4.1	8.4
Average calving date	March 19	March 23
Average birth weight	90.6	88.5
Calving ease	1.57	1.75
55-day adjusted weight	196.0	180.3
205-day adjusted weight		
no. of calves	39	47
adjusted weight	528.6	524.0

The Effects of Rumensin[1], Protein, Energy, and Post-weaning Illness on Reproductive Performance in Replacement Heifers

L. R. Sprott, G. H. Kiracofe, L. R. Corah, and J. Riley

Summary

Rumensin increased the number of heifers cycling at 394 days of age and tended to decrease the weight at puberty, with no effect on conception or pregnancy. Rumensin also increased average daily gain, total weight change, and feed efficiency. Protein level had no direct effect on reproductive or heifer performance. Heifers on higher energy rations tended to cycle sooner and be younger and lighter at puberty. Higher energy rations caused faster daily gain, more total weight change, and better feed efficiency. Post-weaning sickness had no effect on reproductive performance or growth.

Introduction

Recent work at Kansas State and Texas A & M indicates that Rumensin decreases the age and weight at puberty in beef heifers with no effect on conception rates. Energy and protein levels of replacement heifers affect both the onset of puberty and conception. The purposes of this study were to determine the effects of Rumensin, energy, and protein level on time to puberty and conception rates in beef replacement heifers. We attempted to determine any interactions between Rumensin and energy and protein levels. Data were also collected concerning effects of post-weaning sickness on reproductive and feedlot performance.

Procedure

After a 30-day adjustment period in the dry lot, 168 Angus and Angus x Hereford heifers were allotted by weight, age, and breed to one of four treatments shown in table 6.1. Half of each treatment received 200 mg Rumensin per head per day.

To determine the onset of puberty (first standing estrus), twice-daily estrus checks were initiated on the day the heifers arrived at the drylot and maintained through the breeding season. From May 20 to July 18, heifers were artificially inseminated by one technician using semen from a single ejaculation.

Results and Discussion

There were no statistical interactions between Rumensin and energy and protein levels in the diet. Table 6.2 shows that Rumensin tended to de-

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[1]Rumensin is a product of Elanco Products Company, Indianapolis, IN 46206.

crease the age and weight at puberty (P>.05). Rumensin increased the percentage of heifers cycling by 394 days of age (P<.05), and there was a similar trend prior to that time. By 434 days of age, there was no difference in number of heifers cycling. There was no difference in first service conception rates, but pregnancy rates 60 days after breeding tended to be lower in Rumensin heifers. Only the number of heifers cycling at 394 days was statistically different. Average daily gain and total weight change were higher (P<.05) in Rumensin heifers. Consequently, Rumensin heifers gained more on less feed.

Protein level had no effect on age and weight at puberty. Heifers on 8.85 lb TDN per head per day tended to be younger and lighter at puberty (table 6.3). There was a tendency towards more cycling heifers in the higher energy groups. Protein and energy had no effect on first service conception or pregnancy rates. However, heifers on the higher energy rations gained faster (P<.05) and, consequently, had better feed efficiency than heifers on the low protein-low energy ration.

Table 6.4 shows that post-weaning sickness had no effect on age and weight at puberty. There was a tendency (not statistically significant) towards higher conception and pregnancy rates in heifers having no illness periods. A non-significant trend towards higher daily gain, total weight change, and better feed efficiency was seen in heifers that had no illness or only one illness period. However, post-weaning sickness had no effect on reproductive performance or gain.

Table 6.1. Number of cattle per treatment.

	11.1% crude protein (1.50 lb/hd/day)	12.7% crude protein (1.73 lb/hd/day)	14.6% crude protein (1.99 lb/hd/day)
High energy 8.85 lb TDN/hd/day	42 head	42 head	42 head
Low energy 8.30 lb TDN/hd/day	42 head	-----	-----

Table 6.2. Effects of Rumensin on heifer gains and reproductive performance.

	Rumensin	No rumensin
Average days of age at weaning (start of treatment)	214.0	210.6
Average days of age at puberty	356.7	367.5
Average weight at puberty (lbs)	611.0	631.8
Percent cycling by days of age:		
234	5	8
314	24	17
394	67[a]	46[b]
(start of breeding) 434	94	93
Percent first service conception	69.5	70.4
Percent pregnant 60 days after breeding	80.5	87.6
Average daily gain (lbs)	1.48[a]	1.38[b]
Total weight change after 278 days (lbs)	411.8[a]	385.0[b]
Feed efficiency (lbs of dry matter/lb of gain)	9.2[a]	10.1[b]

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

Table 6.3. Effects of protein and energy on heifer gains and reproductive performance.

	11.1% crude protein		12.7% crude protein	14.6% crude protein
Energy level	8.30 lb TDN per head per day	8.85 lb TDN per head per day	8.85 lb TDN per head per day	8.85 lb TDN per head per day
Average days of age at weaning (start of treatment)	212.3	211.1	211.0	214.8
Average days of age at puberty	372.0	358.0	351.4	367.0
Average weight at puberty (lbs)	628.0	617.5	609.0	631.0
Percent cycling by days of age:				
234	5	7	7	7
314	17	24	26	14
394	46	64	62	58
(start of breeding) 434	93	90	95	97
Percent first service conception	72	67	68	73
Percent pregnant after 60 days of breeding	85	81	83	88
Average daily gain (lbs)	1.28[a]	1.42[b]	1.41[b]	1.42[b]
Total weight change (lbs) after 278 days	366.9[a]	400.3[b]	392.0[b]	394.8[b]
Feed efficiency (lbs of dry matter per lb of gain)	11.18[a]	9.6[b]	9.8[b]	9.7[b]

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

Table 6.4. Effect of sickness on heifer gains and reproductive performance.

	Illness periods		
	0	1	>1
No. of heifers	89	66	13
Avg. age at puberty (days)	338.0	344.4	342.8
Avg. weight at puberty (lb)	599.9	601.9	578.2
Percent first service conception	72	69	61
Percent pregnant 60 days after breeding	83	80	76
Avg. daily gain (lb)	1.40	1.45	1.35
Total weight change (lb)	391.4	403.3	376.5
Feed efficiency (lbs of dry matter per lb of gain)	9.7	9.4	10.0

Effect of Various Levels of Ralgro[1] on Reproductive Performance of Yearling Heifers

Larry Corah, L. R. Sprott, Gene Francis, and G. Kiracofe

Summary

Implanting heifers at weaning time with 12, 24, or 36 mg of Ralgro did not affect reproductive performance of the heifers when bred as yearlings.

However, using growth promoting implants with replacement heifers is not recommended.

Introduction

Trials in the United States and overseas have shown that Ralgro improves gain and feed efficiency of feedlot heifers from 0 to 20%. However, data are limited on how Ralgro affects reproductive performance of heifers. At Purdue, 36 mg of Ralgro at weaning time increased rate of gain but decreased reproductive performance slightly, and 72 mg further decreased reproductive performance. Recent data from Montana compared heifers implanted at weaning and approximately 100 days later with heifers not implanted. First-year results showed no effect on reproductive performance, with a slight reduction the next year.

We studied the effects of 12, 24, and 36 mg of Ralgro at weaning on weight gains, pelvic area, and reproductive performance of yearling heifers.

Experimental Procedure

The trial involved 105 Angus heifers on the Gene Gates[2] ranch at Coldwater, Kansas.

On October 17, 1978, the heifers were weighed, weaned, and randomly assigned into one of four treatments in table 7.1. At weighing and implanting, the heifers were 9 to 10 months old.

After they were weaned, the heifers were maintained as one group throughout the trial. On February 7, 1979, they were re-weighed and the pelvic

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[1]Ralgro (Zeranol acetate) is a product of International Minerals & Chemical Corporation.

[2]Appreciation is expressed to Comanche County rancher Gene Gates for use of cattle and help in conducting the trial.

area was measured. On March 29, 1979, they were bred by AI for about 30 days, and then exposed to a bull for another 35 days. On August 7, 1979, conception rates were determined by palpation.

Results and Discussion

Effects of Ralgro (12, 24, 36 mg) on weight gain (113 days), pelvic area, and reproduction are shown in table 7.1.

Heifers receiving 24 mg of Ralgro were 18.2 pounds heavier (22% more gain) than controls. In contrast to previous research, 36 mg of Ralgro did not increase weight gain. Both 24 mg and 36 mg of Ralgro increased the pelvic area.

Percentages of heifers detected in heat the first 21 days of the breeding season ranged from 76.9 for those receiving 36 mg of Ralgro to 88.5 for those receiving 12 mg. Overall conception rate was 95.2%. Using 36 mg of Ralgro reduced conception rate 7.8% below controls. This difference was not statistically significant. None of three heifers detected open in the 36-mg Ralgro group had cycled during the 21-day AI period.

Table 7.1. Effects of indicated levels of Ralgro on weight gains, pelvic area, and reproductive performance of yearling heifers.

Ralgro	No. heifers	Start. wt,lbs	Final wt,lbs	Lbs. gained	Pelvic area (sq cm)	Conception, %	Detected in heat 1st 21 days, %
0	27	524.0	614.6	90.6[b]	158.6[b]	96.3	81.5
12 mg	26	522.5	608.7	86.2[b]	159.3[b]	100.0	88.5
24 mg	26	508.1	616.9	108.8[a]	173.0[a]	96.2	84.6
36 mg	26	515.9	605.3	89.4[b]	172.1[a]	88.5	76.9

[a,b]Means in columns with different superscripts are significantly different ($P<.05$).

Intake of Milk and Range Forage by Nursing Calves

A. Peischel, R. R. Schalles, C. Owensby, and E. F. Smith

Summary

Adequate milk production by the cow to promote fast gain by her calf the first three months is important for heavy weaning weights. Calves consume considerable range forage by three months of age, and milk consumption begins to decrease. As grass begins to mature in September, milk from the dam and range forage eaten by the calf (as a percentage of body weight) decrease to below recommended protein level, so gains decrease. Weaning calves and placing them on a higher nutrition level in late August or early September may be considered when continued fast gains are desired.

Introduction

Weaning weight of calves, a major influence on net income from a cow-calf operation, is largely determined by the milking ability of the cow and range forage intake by the calf. This study measured milk and forage intakes by calves and the relationship of the intake to gain and weaning weight.

Experimental Procedure

We used 78 Polled Hereford calves from spring calving cows grazing year-round on native Flint Hills range during 1977 and 1978. Stocking rate was 8 acres per cow-calf pair on range in good condition. Eight calves were esophogeally fistulated at about one month of age and used to obtain forage samples. Range forage consumption was measured with chromic oxide as an external indicator, and *in vitro* digestibility was measured. Milk consumption was measured by separating calves from cows for 12 hours and weighing calves before and after they nursed. Milk samples were obtained by hand milking cows with the calves nearby.

Calves were born in March and April (average March 24) with an average birth weight of 77 lbs. Calves were weaned in early October at an average age of 200 days and average weaning weight of 400 lbs.

Results and Discussion

Calves consumed from 1.5 to 4% of their body weight in dry matter (milk and grass). Milk made up the entire diet in April and May and decreased to only 13% (dry matter basis) in September. It provided about ½ lb of digestible protein per day. The digestible energy from milk decreased from 100% in April and May to 32% in September.

Average milk consumption was 13.6 lb in April, 16.7 lb in May, 14.6 lb in June, 15.1 lb in July and 12.4 lb in August and September. Calves from cows 5 through 9 years old consumed more milk than calves from either older or younger cows. Age of dam had no effect on calf growth other than through milk production.

Cows fat when their calves were weaned had produced less milk during the summer; however, larger cows tended to produce more milk than smaller cows. For each additional lb of milk consumed per day, the calves were 9 lb heavier at weaning. For each additional lb of range forage dry matter intake per day, the calves were 7 lb heavier at weaning. Calves that received the most milk early (April, May, and June) consumed more range forage, gained faster, and were heavier at weaning.

Range forage intake was low (not measurable) during April and May (figure 1). In June, calves were eating 1½% of their body weight in range forage dry matter. Forage dry matter intake increased to 2% of body weight in July and 2.9% in August. As the grass matured in September, forage dry matter intake decreased to 2.4% of the calf's body weight. During August and September, the dam's milk production had decreased, resulting in ADG being reduced from 2 lb per day in August to 1½ lb per day in September. Digestible protein also was below the recommended level in September.

NUTRIENT INTAKE BY CALVES DURING SUMMER

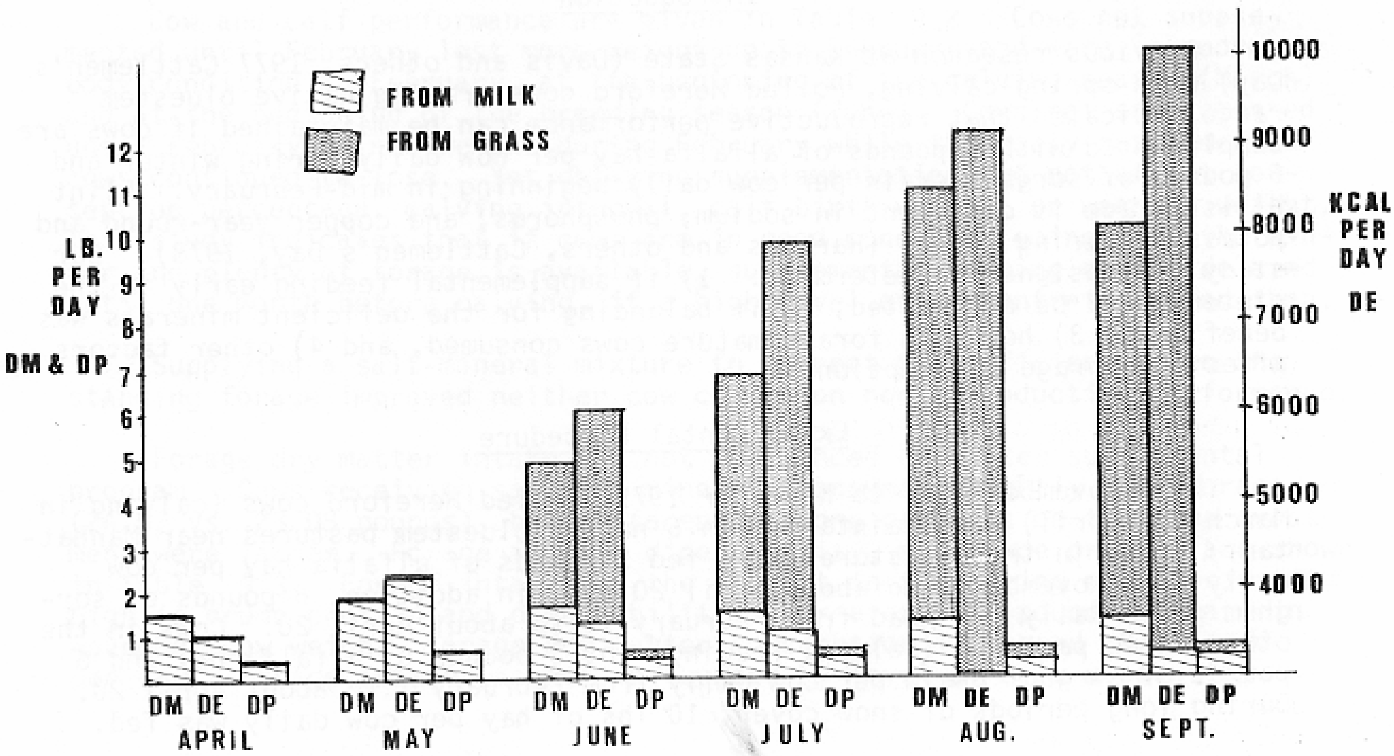

Figure 1. Dry matter (DM) and digestible protein (DP) intake increased from April through August and decreased in September. Digestible energy (DE) intake increased each month. Rate of gain decreased in September.

Performance and Forage Intake of Range Cows as Affected by Mineral Supplement and Delaying Winter Supplemental Feed

R. J. Pruitt, H. A. Peischel, E. F. Smith,
R. R. Schalles, and C. Owensby

Summary

Polled Hereford cows on native Flint Hills pasture not supplemented until February lost more weight from November to February and were in poorer condition during the winter and early spring than cows supplemented beginning in November. But birth weights, weaning weights, conception percentages, and calving intervals were similar for both groups. Balancing for phosphorus, potassium, and copper deficiencies in the forage did not improve cow or calf performance. Forage intake ranged from 1.70% of fall body weight when dormant winter grass was low in protein and digestibility to 3.45% when spring grass was higher in protein and more digestible. Forage intake was not influenced by winter supplement program but was slightly higher when minerals were fed. Although forage consumption increased with cow size, it was not affected by level of milk production.

Introduction

Previous research at Kansas State (Davis and others, 1977 Cattlemen's Day) with spring-calving, Polled Hereford cows grazing native bluestem range indicated that reproductive performance can be maintained if cows are supplemented with 3 pounds of alfalfa hay per cow daily during winter and 6 pounds of sorghum grain per cow daily beginning in mid-February. Flint Hills forage is deficient in sodium, phosphorus, and copper year-round and potassium during winter (Harbers and others, Cattlemen's Day, 1978). Our study was designed to determine: 1) if supplemental feeding early in the winter could be eliminated, 2) if balancing for the deficient minerals was beneficial, 3) how much forage mature cows consumed, and 4) other factors affecting forage consumption.

Experimental Procedure

From November 1977 to November 1979, Polled Hereford cows (calving in March and April) were maintained in 6 native bluestem pastures near Manhattan. Those in three pastures were fed 3 pounds of alfalfa hay per cow daily from November 1 to about April 20 and, in addition, 6 pounds of sorghum grain daily per head from February 15 to about April 20. Cows in the other three pastures (delayed feeding) got 3 pounds of alfalfa hay and 6 pounds of sorghum grain per cow daily from February 1 to about April 20. During long periods of snow cover, 10 lbs of hay per cow daily was fed.

One pasture of each winter supplement group received a salt-mineral mixture year-round, and the other 4 pastures received only salt free choice.

We assumed 16.5 lbs of grass intake per day and 30 lbs in the summer (dry basis). Then, using grass analysis from Harbers and others (Cattlemen's Day, 1978), we formulated and fed a mineral mixture to meet NRC (1976) requirements for sodium, potassium, phosphorus, and copper. For the first winter, no minerals were credited to alfalfa hay, and soybean meal was added to insure desired mineral intake. Equal amounts of soybean meal were added to all pastures. During the second winter, an allowance for the minerals in alfalfa hay was included and no soybean meal was added. Content and intake of the mineral mixture are given in Table 9.1.

During the first year, forage intake was measured for 52 cows in four pastures in November, December, and monthly from March through October. Forage intake was estimated from fecal output (chromic oxide) and forage indigestibility (*in vitro* dry matter disappearance on samples from esophageally fistulated steers). We assumed that level of supplement did not influence forage digestibility.

Cows were exposed to Polled Hereford bulls for sixty days beginning May 25. Weights were taken near the first of the month after cows were held off feed and water overnight. Only cows weaning a calf were included in the analysis of weight change and condition. Only pregnant cows were used for analysis of forage intake for November through March, and only lactating cows for April through October.

Results and Discussion

Cow and calf performance are given in Table 9.2. Cows not supplemented until February lost more weight up to February and were in poorer body condition in February, at the beginning of the calving season (March), and at the beginning of the breeding season (June). Cows not supplemented until February gained weight during February while the early supplemented cows continued to lose. Yet delaying supplementation did not affect conception percentage, calving interval, calf birth weight, or weaning weight. This study indicates that if cows are in good condition going into the winter and plenty of forage is available, supplemental feeding can be delayed until one month before calving, if a high level of concentrate is fed then.

Supplying a salt-mineral mixture to correct for deficiencies in the standing forage improved neither cow condition nor reproductive performance.

Forage dry matter intake was not influenced by winter supplemental program. Cows receiving salt and minerals consumed slightly more forage (24.07 vs. 23.08 pounds), but differences among pastures on the same treatment were larger. Forage intake, digestibility, and crude protein are shown in Table 9.3. Forage intake was the highest in the spring when forage is high in crude protein and digestibility. For every 100 pound increase in November cow weight, forage dry matter consumption increased .974 pound per day. Forage intake was not influenced by level of milk production.

Table 9.1. Intake of salt, mineral, and soybean meal (pounds per cow daily).

	1977-1978						1978-1979					
	November 14-May 7		May 8-July 31		August 1-October 30		November 1-February 4		February 5-June 11		June 12-October 14	
	Salt + mineral	Salt	Salt + mineral	Salt	Salt + mineral	Salt	Salt + mineral	Salt	Salt + mineral	Salt	Salt + mineral	Salt
Salt	.019	.208	.037	.124	.020	.075	.021[1] (.014)	.079	.054	.060	.035	.087
Soybean meal	.223	.222	----	----	----	----	---- (----)	----	----	----	----	----
Potassium chloride	.188	----	----	----	----	----	---- (.076)	----	----	----	----	----
Dicalcium phosphate	.169	----	.147	----	.057	----	.107 (.099)	----	----	----	.088	----
Trace mineral mix[2]	.008	----	.012	----	.004	----	.001 (.001)	----	----	----	.006	----

[1]Figures not in parentheses are for cows fed alfalfa during this period (winter supplement began Nov. 1). Figures in parentheses are for cows not supplemented until Feb. 1.

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

Table 9.2. Cow and calf performance with indicated supplements.

	Supplemental feeding		Mineral treatment	
	Begun Nov. 1	Begun Feb. 1	Salt + mineral	Salt
Cows per treatment	61	72	47	86
Calf birth weight, lbs	75	77	76	76
Weaning weight, lbs	380	389	386	383
Number of cows open	2	1	2	1
Calving interval*	363	363	361	365
Beginning Nov. cow wt., lbs	1072	1039	1057	1055
Weight change, lbs				
November to February	- 73[a]	-105[b]	-104[a]	- 73[b]
February to March	- 16[a]	+ 10[b]	+ 6[a]	- 12[b]
March to June	- 71	- 72	- 76	- 68
June to November	+156	+167	+162	+161
Ending Nov. cow wt., lbs	1068	1039	1046	1062
Weight to height ratio (lbs/in.)**				
Beginning November	23.19	22.50	22.81	22.87
February	21.62[a]	20.23[b]	20.56	21.29
March	21.29[a]	20.44[b]	20.71	21.02
June	19.74[a]	18.86[b]	19.07	19.53
Ending November	23.13	22.50	22.60	23.03

*Includes only 1 year.

[a,b]Within supplemental feeding or mineral treatment, means with different superscripts differ significantly (P<.05).

**Weight in pounds divided by height in inches at the withers. Used as an indication of condition. A lower ratio indicates a thinner animal.

Table 9.3. Monthly forage intake per cow daily.

Month	Number of cows	Monthly cow weight, lbs.[1]	Forage dry matter intake: lbs[2]	Forage dry matter intake: lbs/100 lbs. Nov. wt.[3]	Crude protein (%)	Forage digestibility (%)
November	44	1065	17.90± .88[a]	1.70±.08[a]	6.80	44.04
December	44	1043	21.08± .88[bc]	2.00±.08[b]	6.28	48.30
March	30	966	18.21±1.04[ab]	1.70±.10[a]	4.78	38.79
April	33	816	26.96±1.01[d]	2.54±.09[c]	10.53	47.54
May	37	825	19.32± .95[e]	2.73±.09[c]	15.23	61.26
June	33	899	37.10±1.01[f]	3.45±.09[d]	12.73	64.74
July	34	959	21.76± .99[c]	2.05±.09[b]	10.19	41.04
August	36	1021	20.77± .97[bc]	1.94±.09[ab]	8.26	35.74
September	37	1030	20.22± .95[abc]	1.90±.09[ab]	8.16	42.89
October	37	1003	21.87± .95[c]	2.04±.09[b]	8.67	46.70

[1] Only weights of cows included in that month's forage intake.

[2] The statistical model included month, mineral treatment, pasture within mineral treatment, age, and November weight.

[3] The statistical model included month, mineral treatment, pasture within mineral treatment, and age.

[a,b,c,d,e,f] Means in a column with different superscripts differ significantly ($P<.05$).

Rumensin and Drylot vs. Pasture Systems for Early-weaned Calves[1]

W. D. Busby, L. R. Corah, M. McKee, G. Fink, and R. Pope

Summary

Seventy-six Polled Hereford and percentage Simmental calves were used to evaluate Rumensin and drylot vs. pasture systems by average daily gain of early-weaned (54 day old) calves. Rumensin was fed at 10 g/ton of feed for 28 days and 20 g/ton thereafter. The starter and standard creep rations were self-fed to both the drylot and pasture groups.

Drylot calves outgained calves on pearl millet pasture 196 lbs to 140 lbs during the 76-day pasture trial. Rumensin decreased fecal samples containing coccidial oocytes and improved total gain 5.5% and feed efficiency 4.8%.

Introduction

Early weaning can be useful in the following situations: 1) emergency conditions such as drought, 2) drylot systems, 3) accelerated rebreeding of heifers after first and second calves, 4) fall calving where heavy winter feeding would be required, and 5) induced twinning. Previous work here (1975 and 1976 Cattlemen's Day) showed that energy was used more efficiently by early weaning calves.

Rumensin has improved weight gain and feed efficiency in calves weighing over 400 lbs; however, data are limited on its benefits for young, small calves.

Experimental Procedure

Seventy-six Polled Hereford and percentage Simmental calves, all born in confinement, were weaned at 30 to 80 days of age (average, 54) and allotted by age, weight, sex, and breed to four treatment groups: 1) Rumensin and drylot, 2) control and drylot, 3) Rumensin and hybrid pearl millet pasture, and 4) control and hybrid pearl millet pasture. Two groups of early weaned calves were involved; the first (60 head) were weaned May 11 (avg. age, 56 days) and allotted equally to the 4 treatment groups. The second group of later born calves (16 head) were weaned June 6 (avg. age, 43 days) and allotted to either Rumensin and drylot or control and drylot. After calves were weaned, they were housed indoors 12 days preceding the trial with access to the control starter creep *ad libitum* (table 10.1) and fresh

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[1]Rumensin is a trade name of Elanco Products Co., Division of Eli Lilly and Company, Indianapolis, IN 46206.

water. Calves were housed outside during the trial. Rumensin calves received the starter creep *ad libitum* with 10 g Rumensin/ton. All drylot calves received 1 lb/day of native grass hay after day 21. After 28 days, Rumensin in the starter creep was increased to 20 g/ton. After day 50, 2 groups of calves were pastured on hybrid pearl millet 76 days, and 2 groups remained in drylot. On day 57, all calves were switched from starter creep to standard creep.

Initial weights were taken after 5 hours off feed and water; final weights, after 12 hours off feed and water. Fecal samples were collected on days 0, 14, and 29 and analyzed for coccidial oocytes.

Bull calves will continue receiving Rumensin to determine its effect on bull reproduction. Results will be reported later.

Results and Discussion

Results are shown in table 10.2. Drylot calves gained more than calves on pearl millet pasture. Regardless of sex or breed, calves responded to Rumensin similarly whether in drylot or on pasture.

Fourteen of sixteen fecal samples taken at the start of the trial had coccidial oocytes. Two weeks later, 1 of 9 samples from calves receiving Rumensin and 5 of 9 control samples had coccidial oocytes. Samples taken 15 days later showed no oocytes in either group.

The weight gain from day 21 to 51 was significantly greater for the Rumensin vs. control calves. Feed efficiency for drylot calves on Rumensin was 4.14 vs. 4.34 for controls.

Table 10.1. Creep rations for early-weaned calves

Ingredient	Starter ration (%)	Standard creep ration (%)
Rolled oats	21.85	65.30
Rolled corn	36.74	18.30
Soybean oil meal	21.85	4.62
Calf Manna[a]	14.90	---
Fat	1.49	1.52
Dry molasses	---	5.08
Dehydrated alfalfa	---	4.57
Salt	.99	.51
K-State Swine Vitamin Premix[b]	.99	---
Dicalcium phosphate	.60	---
Limestone	.60	---
Z 10 trace mineral[c]	---	.05
Vitamin A (30,000 IU/lb)	---	.04

[a]Calf Manna is made by Albers Milling Company.

[b]Premix contains: Vitamin A, Vitamin D, Riboflavin, d-calcium pantothenate, choline chloride, niacin, Vitamin E and Vitamin B_{12}.

[c]Z 10 trace mineral is made by Calcium Carbonate Co.

Table 10.2. Performances of early-weaned calves fed Rumensin and drylot vs. pasture systems.

	Control	Rumensin	Pasture	Drylot
No. of head	38	38	30	30
No. of days on trial	114	114	76	76
Average birth date	March 22	March 20	---	---
Average age at weaning (days)	53.6	53.3	---	---
Initial weight, lbs	207.4	208.4	333.5	335.8
Final weight, lbs	479.1	491.0	474.0	531.5
Total gain	271.7	282.6	140.5	195.7
ADG	2.38	2.48	1.85	2.58
Total feed intake/lb of gain* (Drylot reps only 23 hd/treatment)	4.34	4.14	---	---
Creep ration consumption/head/day	---	---	9.78	13.91

*Values reported on as-fed basis with the ration containing 89.1% dry matter.

Effect of Ralgro[1] on the Performance of Cull Beef Cows

L. R. Corah, F. Brazle[2], and J. D. Dawes

Summary

We assigned 110 cull beef cows of mixed breeding to a control group and a group implanted with 36 mg Ralgro. Ralgro implants improved gains 12.8 lbs (11.2%) over a 59-day grazing period.

Introduction

Numerous research trials have shown that Ralgro improves weight gain and feed efficiency of suckling calves, growing calves, and feedlot cattle by from 4 to 15%. A Montana study shows 10.3% and 17.1% faster gain in two trials with cull cows on native range grass.

We ran this study to see how cull cows responded to Ralgro.

Experimental Procedure

The trial, conducted at the Jim Becker[3] ranch near Howard, Ks., involved 110 open cows of mixed breeding. They were allotted randomly April 10, 1979; 55 to the implant group (36 mg), and 55 to the control group. Condition was estimated by the height-weight ratio system. Cows were grazed on fescue for 59 days, and final weights were taken June 15, 1979. The cows were weighed directly off pasture at both the start and end. All cows were dewormed before the trial began.

Results and Discussion

The starting weight, final weight, and weight gains are shown in table 11.1. All cows were very thin when the trial started.

Implanted cows gained 12.8 pounds (11.2%) more weight during the 59-day experimental period, which is fairly consistent with the work from Montana.

Initial weight and weight-to-height ratio (condition) did not influence average daily gain. The correlation between weight gain and weight-

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[1]Ralgro (Zeranol) is a product of International Minerals and Chemical Corporation.

[2]Frank Brazle is SE Extension Livestock Specialist, and J. D. Dawes is Elk County Agent.

[3]Appreciation is expressed to Elk County rancher Jim Becker for use of the cattle and cooperation in conducting the trial.

to-height ratio was virtually zero, and the correlation between weight gain and initial weight was nonsignificant (.11). All cattle starting the trial in a very thin condition may explain why weight-to-height ratio (condition) had no effect on average daily gain. Likewise, their thin condition may explain why starting weight had no influence on weight gained during the grazing period.

Table 11.1. Effect of Ralgro on the weight gains of open, mature, cull cows.

Treatment	No.	Starting weight, lbs	Final weight, lbs	Lbs gained	ADG lbs/day
Control	55	767.5	881.5	114.0	1.93
Implanted	55	740.7	867.5	126.8	2.15

KSU

Grazing Cattle on Alfalfa[1]

Doug Hayes, Larry Corah, and E. E. Bartley

Summary

Data collected from six producers grazing 4050 head of cattle on 850 acres of irrigated alfalfa showed that under optimum conditions, Kansas producers can expect: stocking rate, 5 to 6 head/acre; average daily gain, 2 lbs +; total pounds of beef/acre, 1300 to 1500 lbs; and death loss below 1%. Bloat Guard[2,3] performed the best when added to a grain supplement.

Introduction

Cattle have grazed alfalfa for many years, with various degrees of success depending on how well bloat was controlled. In more recent years, the clearance of poloxalene (Bloat Guard) and its incorporation into various feeding systems has generated increased interest in grazing irrigated alfalfa, most notably in Texas, Utah, and Idaho. The concept, however, has not been popular in the High Plains. In 1979, because of favorable cattle prices, less demand for alfalfa by dehydrating plants, and increasing fuel costs, interest in grazing alfalfa increased. To collect production and economic data on alfalfa grazing, we worked with six cooperating producers in south central and southwest Kansas.

Procedures

All six locations were irrigated; five with circle irrigators, one by a flood system. Stands varied from young and lush to fairly old with grass and weeds intruding.

Each pasture was split into six plots for rotational grazing. Cattle grazed each plot four to seven days. Producers attempted to move the cattle to a fresh plot before the alfalfa reached one-tenth bloom, except on the initial rotation, when grazing was either started on very immature

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[1]Appreciation is expressed to the following people for their cooperation in obtaining part of the information: Harold Koehn and Bruce Wilson of Pawnee Beef Builders, Larned; Lee Borck and Brian Ward of Ward Feedyard, Larned; Harold Burnett of Burnett Feedlot, Scot City; Dale and Jerry Mott, Iuka; Terry and Jim Sallee, St. John; and Bob and Barry Kane, Kismet. Also, the help of Dr. Larry Kennedy of Smith Kline Corporation is gratefully acknowledged.

[2]Bloat Guard is a product of Smith Kline Animal Health Products.

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

alfalfa or half the pasture was harvested as hay--so alfalfa would be in the proper stage of growth when cattle were placed on it.

At two of the six locations, Bloat Guard was fed in liquid supplement. At the other four locations, it was added to a grain or grain-silage mixture. Three of the four fed once daily; one, twice daily. Dry roughage (wheat straw, old sudangrass hay, milo stover, rye hay, or alfalfa hay) was offered free choice at four of the locations to prevent bloat, slow alfalfa removal from the rumen, "stretch" the pasture, or for a combination of those reasons.

Weights were taken on some of the cattle at all locations for an indication of average daily gain and total pounds of beef produced per acre.

At four locations the cattle were grazed on a "custom" basis, charging customers 35 to 40 cents/pound of gain. At two locations, the alfalfa was leased. One location paid 20 cents/pound of gain; the other, 35 cents/head/day.

At two of the six locations, cattle numbers could be adjusted to alfalfa growth, and at those locations, some cattle were placed on the alfalfa one to three months and then removed with another group replacing them.

Results and Discussion

Stocking Rate - The stocking rate averaged 3.7 head/acre (table 12.1) with cattle ranging from 400 to about 600 pounds. Quality of the alfalfa stand was the principle factor influencing the stocking rate. Our results indicated that, under Kansas growing conditions, the optimum stocking rate with 400- to 450-pound cattle is five to six head/acre.

Daily Gain - The average daily gains were somewhat lower than anticipated (table 12.1). Work in other states has consistently shown daily gains of 1.7 to 2.0 pounds. At some locations, the alfalfa was more mature than desired during the initial rotation. This may have reduced gains slightly.

Pounds of Beef per Acre - Our average beef production per acre (578 lbs) was much lower than the 1500 lbs per acre frequently seen in the southern Great Plains, where grazing periods are longer and stocking rates higher.

Grazing Period - Our average grazing period was only 93 days. But under optimum grazing conditions in Kansas, a 150-day grazing period might be expected. At one of the six locations, the cattle were removed fairly early because of difficulties in keeping them confined and subsequent bloat problems. At two other locations, grazing was not started until early June.

Hay Harvested per Acre - At some locations, hay was taken off pasture in the initial rotation. At one location, two plots were harvested during grazing, due to understocking. Hay harvested averaged .6 ton/acre.

Death Loss to Bloat - When high death loss from bloat occurred, intake of liquid supplement was not consistent or cattle got out of the designated plot. Fence-crawling led to considerable bloating. Bloat Guard added to

grain generally controlled bloat well. Deaths from bloating ranged from none to 5.5%.

Poloxalene Intake - In most cases, from 1½ to 2 grams of poloxalene, the recommended level, was fed per 100 pounds of body weight per day.

Supplemental Feed per Head per Day - Supplemental feed intake was calculated on the basis of original moisture, even when liquid supplement was fed. Silage was converted to 90% dry matter.

Supplemental feed varied widely from location to location. Liquid supplement, when fed, usually was the only feed other than some dry hay or stover. When Bloat Guard was added to grain, the grain often included minerals, salt, and vitamins. The grain varied from ground milo to steam-flaked corn. At two locations, the cattle came to the bunks at the sight of a feed truck; at the other two, they had to be driven in, and at one they were locked in the bunk area one hour before feeding to induce more even consumption and, hence, bloat protection. That practice gave zero death losses from bloat. The other two custom feeders who fed grain as the Bloat Guard carrier also had few bloat problems.

Table 12.1. Results from 6 alfalfa grazing demonstrations in Kansas in 1979.

Trait	Average	Range
Total no. cattle at 6 locations	4050	---
Total acres of alfalfa grazed at 6 locations	850	---
Average stocking rate (cattle/acre)	3.7	2.2 to 4.76
Average daily gain (lbs/day)	1.54	1.2 to 2.0
Average lbs beef produced/acre*	578	347 to 836
Average no. grazing days	93	69 to 139
Amount of hay harvested/acre (ton)	.6	0 to 1.75
Average death loss due to bloat, %	2.38	0 to 5.5
Poloxalene intake (grams/animal/day)	9.04	6 to 12
Average lbs of supplemental feed/head/day**	3.35	2 to 5.1

* Based on only 5 locations.
**Silage converted to 90% dry matter. All other supplements, including liquid supplements, averaged at original moisture level.

Management Recommendations When Grazing Alfalfa

Based on the extensive demonstration work from Texas, our field experiences in Kansas in 1979 and work done earlier at Kansas State, we recommend the following management practices when grazing alfalfa.

1) To get animals accustomed to Bloat Guard, give cattle access to it 2 to 5 days before turning them on alfalfa. To prevent bloat, Bloat Guard must be in the rumen before alfalfa is eaten.

2) When starting, use higher dosages of the drug than recommended, then, if no bloat occurs, reduce drug dosage. Increase dosages when alfalfa is lush and decrease dosages when it is mature.

3) Turn cattle on alfalfa for the first time about mid-morning after they have filled on other roughage. Then leave them on pasture constantly, even at night. Never let cattle get hungry while grazing. Check the cattle at least twice daily; more often if any of them bloat.

4) Although prebloom alfalfa can be grazed with little bloat, mature alfalfa (1/10 bloom or later) should be used when first starting.

5) Stock established alfalfa at 5 to 7 head of 400-lb cattle per acre. Hay which will produce 6 tons per acre of alfalfa will support 5 head per acre.

6) Fence the pasture into six equal sections. Graze each section five days, then rotate to the next section to allow 25 days for regrowth between grazing periods--to maintain good stands and good production with minimum trampling.

7) Irrigate as needed to sustain maximum production. Usually, plots are watered behind the cattle so that they do not graze on wet ground. On well drained, sandy soils, however, it is possible to water over the cattle with little or no trampling of the stand.

8) To prevent excessive trampling during wet weather, especially on clay soils. feed hay in another location.

9) Having dry roughage available all the time helps reduce bloat and slow rumen removal rate, thus making better use of the alfalfa.

10) Manage stocking rate and rotation interval carefully. Cattle moved from an overgrazed plot may overeat when moved to a fresh plot, which increases the possibility of bloat. Move cattle to a fresh plot when alfalfa is grazed down to about 4 inches in height.

Overgrazing will increase supplemental feed consumption, thus increasing expense. However, stock heavy enough to insure even grazing. If uneven grazing occurs, the remaining plants become larger and less palatable. Then during regrazing, the animals eat the younger, more tender plants again. That reduces productive acreage unless the large plants are mowed.

11) Alfalfa that is too mature is not palatable and will cause over-

consumption of the supplemental feed.

12) Annual fertilization should be based on annual soil tests.

13) If flies and watery eyes are a problem, use dust bags.

14) If footrot is a problem, use organic iodine.

15) Good fencing is essential. When cattle get through a fence into a new, lush plot with high bloat potential, they may be unable to obtain Bloat Guard. Remove any habitual fence crawlers. Constant surveillance is needed. Use electric fencing. Two strands may be needed if fence crawling is a problem.

16) If Bloat Guard is fed in liquid supplement: a) place lick tanks near water or other areas where cattle congregate; b) provide one lick wheel per 25 head of cattle and at least one lick tank out in the pasture. On larger operations, provide one lick wheel per 50 cattle around the field so animals are never more than 400 yards from a lick tank; c) if underconsumption is a problem, place salt blocks close to, or on top of, lick tanks. Cattle congregate near rubbing posts--a good tank location; d) measure liquid depth in tanks daily and move tanks from areas of low supplement consumption to areas of high consumption; e) Mount tanks on sleds to simplify moving with a pickup truck; f) if overconsumption is a problem, reduce the number of wheels available by removing tanks or by tying down wheels.

17) If Bloat Guard is included with grain: a) add the desired amount to 2 lbs grain and feed once or twice daily. The cost of the grain is returned as extra weight gain. Feeding grain twice a day insures a more even concentration of drug in the rumen; b) if irrigated circles are pastured, place feed bunks around the periphery of the catch pen, which is usually at the pivot. Supply 1.5 to 2.0 feet of bunk space per head. If rectangular fields are pastured, build the catch pen at one side of the field and place the bunks for convenient feeding; c) make sure all cattle are present at the feed bunks before feeding the grain. It may be necessary to drive them to the bunk area; d) use a palatable grain base; e) if any cattle regularly refuse the grain, remove them.

18) If Bloat Guard blocks are used: a) accustom the cattle to blocks at least 3 days before grazing alfalfa; b) place blocks where cattle congregate. Place some blocks near water and some out in the pasture; c) use at least one block per five head of cattle; d) always keep adding a few fresh blocks because some cattle will not consume blocks that have been slobbered on and are stale; e) do not feed any other mineral block or loose mineral. The Bloat Guard blocks contain supplemental mineral and salt.

Summer Annual Silages and Hay for Growing Steers

Keith Bolsen, Harvey Ilg, Dirk Axe and Will Thompson

Summary

Sudangrass, pearl millet, sorghum-sudangrass, and forage sorghum silages and sorghum-sudan hay were full-fed to yearling steers in a 90-day trial. Forage sorghum was harvested in the dough stage; the other four forages, in the late-vegetative stage.

Steers consumed an average of 12.5% more hay than silage the first 42 days; hay feeding was discontinued then for lack of supply.

At 90 days, steers fed forage sorghum silage out-performed those fed the other three silages. Compared with forage sorghum, the other silages had relative feeding values (based on rate and efficiency of gains) of 75% for sudangrass, 62% for pearl millet, and 68% for sorghum-sudan.

Introduction

Summer annuals can produce high yields of high quality forage when harvested at an optimum stage of maturity. Our previous research indicates that hybrid sudangrass, hybrid sorghum-sudangrass, and pearl millet should be harvested in the vegetative to boot stages for highest quality forage and highest yield of digestible nutrients per acre (Progress Report 350, Kansas Agricultural Expt. Station).

In our first cattle trial, early-cut (vegetative) sudangrass and sorghum-sudangrass silages had 90 to 100% the feeding value of dough stage forage sorghum silage, but late-cut (dough stage) sorghum-sudangrass silage had only 70 to 75% the value of forage sorghum silage (Progress Report 320, Kansas Agricultural Expt. Station).

In this experiment, we compared three early-cut summer annual silages and one early-cut summer annual hay with forage sorghum silage in growing cattle rations.

Experimental Procedure

Five forages harvested in the summer and fall, 1978, were compared: 1) sudangrass, 2) pearl millet, 3) forage sorghum, and 4) sorghum-sudan silages and 5) sorghum-sudan hay. First, 2nd, and 3rd cuts of sudangrass and pearl millet and 1st and 2nd cuts of sorghum-sudan were mowed and swathed at late-vegetative growth then field-wilted to 30 to 35% dry matter (DM) before ensiling. Forage sorghum was direct-cut in the dough stage for ensiling. Hay from 2nd cut, late-vegetative sorghum-sudan was made in rectangular

bales (70 to 80 pounds each). All silages were made in 10-ft x 50-ft concrete-stave silos.

Varieties and hybrids were Northrup King Trudan-6 hybrid sudangrass, Northrup King 'Millex 23' hybrid pearl millet, Dekalb FS 25a+ hybrid forage sorghum, and Dekalb 7+ hybrid sorghum-sudan.

Seventy-five yearling steers averaging 738 pounds were allotted to 15 pens with three pens assigned to each of the five forages. The fixed-per-percentage rations contained 84% silage or hay, 12% rolled milo, and 4% supplement[1] on a DM basis; rations were mixed and fed to appetite twice daily. Soybean meal replaced milo in the forage sorghum silage ration. Because the late-vegetative forages ranged from 12.7 to 15.9% crude protein, the protein contents of these four rations varied from 12.2 to 14.9% during the trial. The forage sorghum silage ration averaged 12.5% protein. Hay was chopped with a tub grinder with 2-inch recutter screen before being fed.

All steers had grazed native bluestem pasture during the summer of 1978, and all were full-fed grass hay plus 2 pounds of grain in dry lot for 4 weeks before the feeding trial. Initial, 42-day intermediate, and 90-day final weights were taken after all steers were without feed or water 16 hours.

Results

Dry matter and crude protein contents of the five forages are shown in Table 13.1.

Performances of steers after 42 days are shown in the top half of Table 13.2. When supply of sorghum-sudan hay ran out, steers fed hay had consumed 16% more forage than steers fed the companion (sorghum-sudan) silage and 5 to 17% more forage than steers fed the other three silages. Steers receiving forage sorghum silage made the fastest and most efficient gains at 42 days; those receiving pearl millet silage, the slowest and least efficient.

Performances of steers after 90 days are shown in the bottom half of Table 13.2. Severe winter weather with extremely cold temperatures and heavy snows were responsible for very poor rates and efficiencies of gain the final 48 days; the 60 steers averaged only .43 pounds gain per day.

Overall performance for the 90 days showed steers fed forage sorghum silage gained significantly faster ($P<.05$) and more efficiently ($P<.05$) than steers fed the other three silages. Although differences were small, sudangrass silage gave better performance than either pearl millet or sorghum-sudan silages. During the first 42 days, intakes of sudangrass and pearl millet silages were 1.0 to 1.9 pounds higher than intake of forage sorghum silage. At the end of the 90-day trial, those differences were only .2 to .3 pound per day.

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[1]Supplement ingredients (lbs/ton): rolled milo, 1655; dicalcium phosphate, 160; salt, 125; fat, 30; trace minerals, 5; aurofac -10, 20; and vitamin A premix, 5.

Table 13.1. Analyses of the five forages.

Forage	Dry matter %	Crude protein %, DM basis
Sudangrass silage	36.0	13.4
Pearl millet silage	28.6	14.8
Sorghum-sudan silage	26.0	14.4
Sorghum-sudan hay	88.6	12.9
Forage sorghum silage	29.0	6.3

Table 13.2. Performances by steers fed the indicated five forage rations.

Item	Silage: Sudan-grass	Silage: Pearl millet	Silage: Forage sorghum	Silage: Sorghum-sudan	Hay: Sorghum sudan
	Through 42 days (Nov. 9 to Dec. 21, 1978)				
Initial wt., lbs.	743	741	734	735	740
42-day wt., lbs.	813	807	836	807	814
Avg. daily gain, lbs.	1.67	1.57	2.43	1.71	1.76
Avg. daily feed, lbs.[1]					
silage or hay	17.5	18.4	16.5	16.4	19.3
SBM or milo	2.8	2.6	2.5	2.9	2.8
supplement	.9	.9	.9	.9	1.0
total	21.3	21.9	19.9	20.2	23.1
Feed/lb. of gain, lbs.[1]	12.8	13.8	8.2	11.8	13.2
	Through 90 days (Nov. 9, 1978, to Feb. 7, 1979)				
90-day wt., lbs.	841	821	864	820	
Avg. daily gain, lbs.	1.09	.89	1.44	.94	
Avg. daily feed, lbs.[1]					
silage	17.1	17.2	16.9	16.5	
SBM or milo	2.7	2.6	2.6	2.6	
supplement	.9	.9	.9	.9	
total	20.7	20.7	20.4	20.0	
Feed/lb. of gain, lbs.	19.0	23.4	14.2	21.3	
Avg. daily gain from 42 to 90 days, lbs.	.58	.29	.58	.27	

[1]100% DM basis.

Silage Additives[1]

Keith Bolsen and Harvey Ilg

Summary

Six commercial silage additives were evaluated in five trials with corn, forage sorghum, and alfalfa. In general, each additive improved the silage in at least one of four criteria we used for the comparisons: ensiling temperature, silage dry matter (DM) loss during fermentation, cattle performance, and silage stability in air.

The additives lowered ensiling temperatures during the first week by about 5°F (range, 2.7 to 9.9°F).

Additives consistently reduced DM lost during fermentation. Loss from five control silages averaged 10.0% compared with 4.7% from nine silages with additives.

No silage additive significantly affected rate of gain or silage intake in the four trials with growing cattle. In three of six comparisons, additives increased feed efficiency slightly; but in the other three, additives decreased feed efficiency slightly.

In five comparisons, additives increased aerobic stability of silages on feedout, but again in the other five, additives decreased silage aerobic stability on feedout.

Introduction

Most crops grown in Kansas can be harvested and stored as silage, and good silage fermentation should produce a well-preserved, palatable feed with a minimum loss of nutrients. However, conditions for making silage are not always ideal (i.e., changing weather, equipment breakdown, crops too wet and immature or crops too dry and mature). What can be done to reduce such risks when making silage?

Are commercial silage additives that have appeared on the market the last few years beneficial to silage? Do they lower ensiling temperatures and conserve more of the nutrients in the crop (particularly energy and protein)? Do they produce a more palatable silage with higher feeding value? Do they make silage more resistant to aerobic spoilage when it's being fed? And, finally, do an additive's benefits offset its cost?

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[1]Mention of products and companies is made with the understanding that no discrimination or endorsement is intended. Also, no criticism is implied of products and companies not mentioned.

Our objective in the five reports that follow was to evaluate several commercial silage additives for three common silage crops in Kansas: corn, forage sorghum, and alfalfa.

Experimental Procedures

Many of the procedures were the same in the five trials. Silages were made in 10-ft x 50-ft concrete stave silos from crops obtained at a single source. Harvests were with a Field Queen forage harvester equipped with a 2-inch recutter bar for corn and sorghum and a "haylage" bar for alfalfa. Corn and sorghum were direct-cut, but alfalfa was swathed with a mower-conditioner and field-wilted for approximately 24 hours. Each load of fresh crop was weighed, sampled, and had additives applied at the silo blower. In trials 2 to 5, thermocouple wires were embedded in the silages at uniform spacing, and ensiling temperatures were recorded for 4 to 6 weeks.

Silages were full-fed in rations that were formulated to contain equal amounts of crude protein, minerals, vitamin A, and aureomycin. Ration consumption was recorded daily with feedbunks cleaned periodically (usually every 7 days), so the silage not consumed could be weighed.

All cattle were fed a standard ration of alfalfa and/or prairie hay and grain at a dry matter intake equal to 1.5 to 2.0 percent of body weight for 5 to 7 days before each trial began, and all were weighed individually after 16 hours without feed or water at the start and end of the trials.

During the trials, silage samples were taken weekly from each silo and DM determined. Additional analyses included: proximate, Van Soest, pH, fermentation acids, hot-water insoluble nitrogen, and ammonia nitrogen.

In trials 2 to 5, approximately 50 lbs of fresh silage was obtained from the center of each silo and divided into eight equal lots of 4.4 lbs. Each lot was placed in an expanded polystyrene container lined with plastic, a thermocouple wire was inserted in the center of the silage, and cheesecloth was stretched across the top of the containers, which were stored at 62 to 65 F. Silage temperature was recorded twice daily. At various days after exposure to air, duplicate containers of each silage were weighed, mixed, sampled, and dry matter loss was determined.

Silo-Best for Corn Silage[1]

Keith Bolsen and Jack Riley

Experimental Procedure

Two corn silages (37 to 38% DM) were made September 2 and 3, 1975; one was ensiled without additive (control), the other with Silo-Best added at 1.0 lb. per ton of fresh crop. Silos were opened after 36 days, and each silage was full-fed to 15 yearling steers (3 pens of 5 steers) during an 87-day trial (October 10, 1975, to January 5, 1976). Complete-mixed rations contained 86% silage and 14% soybean meal supplement on a DM basis.

Results

Both silages appeared to be well preserved. Feeding results are shown in Table 15.1. Differences in steer performance were not statistically significant, but steers fed Silo-Best corn silage gained 5.3% faster and 2.9% more efficiently than those fed control corn silage.

Silage DM losses during fermentation and feedout were less for the Silo-Best corn silage (Table 15.2). Silo-Best silage had a 3 percentage unit lower fermentation loss (9.0 vs. 12.0% of the DM put into the silo) than control silage, and twice as much control silage spoiled from heating and molding. During the feeding period, control silage heated within 2 days after being removed from the silo compared with 7 days for the Silo-Best silage. Twice during the trial, control corn silage heated, spoiled, and was removed from the silo and not fed.

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[1] Silo-Best is an enzyme product of Cadco, Inc., 10100 Douglas Ave., Des Moines, IA 50322.

Table 15.1. Performances by yearling steers fed control and Silo-Best corn silages.

Item	Corn silage Control	Corn silage Silo-Best
Initial wt., lbs.	667	666
Avg. daily gain, lbs.	2.45	2.58
Avg. daily feed, lbs.[a]	18.83	19.17
Feed/lb. of gain, lbs.[a]	7.67	7.45

[a]100% dry matter basis.

Table 15.2. Corn silage fermentation and spoilage losses.

Silage	DM put into the silo	DM taken out of the silo and fed	DM not fed (spoilage)	DM lost through fermentation
	lbs.	% of the DM put into the silo		
Control	40,800	80.9	7.1	12.0
Silo-Best	44,800	87.5	3.5	9.0

Silo-Guard for Corn Silage[1]

Keith Bolsen and Harvey Ilg

Experimental Procedure

Two corn silages (34 to 36% DM) were made August 4 and 5, 1976; one was ensiled without additive (control), the other with Silo-Guard added at 1.5 lbs. per ton of fresh crop. Silos were opened after 68 days, and each silage was full-fed to 15 yearling steers (3 pens of 5 steers) during a 91-day trial (October 12, 1976, to January 11, 1977). Complete-mixed rations contained 84% silage and 16% soybean meal supplement on a DM basis.

Results

Both silages appeared to be well preserved. Chemical analyses (Table 16.1) showed that the two silages had similar composition, except Silo-Guard increased propionic acid and decreased acetic acid.

Feeding results are shown in Table 16.2. Steers fed Silo-Guard corn silage gained 3.9% faster and consumed 3.2% more silage than steers fed control corn silage, but these differences were not statistically significant.

Silo-Guard decreased DM lost during fermentation more than 6 percentage units compared to the control (Table 16.3). Ensiling temperatures averaged 5.0°F cooler (84.3 vs. 89.3 F) in the Silo-Guard silage during the first 6 days (Table 16.4). Both silages were stable on feedout with no heating or molding when exposed to air for 7 days.

Table 16.1. Chemical analyses of control and Silo-Guard corn silages.

Silage	Dry matter	pH	Crude protein	Lactic acid	Acetic acid	Propionic acid	Butyric acid
	%		% of the DM				
Control	34.7	4.10	9.4	4.01	2.21	trace	.05
Silo-Guard	35.1	4.20	9.4	4.32	1.73	.26	.03

[1]Silo-Guard is an enzyme (and its co-factors) product of International Stock Food, Inc., P.O. Box 29, Waverly, NY 14892.

Table 16.2. Performances by yearling steers fed control and Silo-Guard corn silages.

Item	Corn silage Control	Silo-Guard
Initial wt., lbs.	764	773
Avg. daily gain, lbs.	2.57	2.67
Avg. daily feed, lbs.[a]	21.93	22.63
Feed/lb. of gain, lbs.[a]	8.61	8.55

[a]100% dry matter basis.

Table 16.3. Corn silage fermentation and spoilage losses.

Silage	DM put into the silo	DM taken out of the silo and fed	DM not fed (spoilage)	DM lost through fermentation
	lbs.	% of the DM put into the silo		
Control	42,600	87.4	3.2	9.5
Silo-Guard	39,200	93.7	3.2	3.1

Table 16.4. Ensiling temperatures for control and Silo-Guard corn silages.[a]

Days post-ensiling	Control	Silo-Guard	Adv.[b]
		°F	
1	83	83	0
2	88.5	83.5	+5
3	91	84	+7
4	91.5	84.5	+7
6	90.5	85.5	+5
9	89	84	+5
17	83	80	+3
20	80.5	78.5	+2
25	80.5	77.5	+3
30	77	75.5	+1.5
35	75	73.5	+1.5

[a]Each value is the mean of six thermocouple readings.
[b]Advantage for additive over control (control minus additive).

Silo-Guard for Forage Sorghum Silage[1]

Keith Bolsen and Harvey Ilg

Experimental Procedure

Two forage sorghum silages (29 to 30% DM) were made October 1 to 3, 1978; one ensiled without additive (control), the other with 1.5 lbs. of Silo-Guard added per ton of fresh crop. Silos were opened after 36 days, and each was full-fed to 15 yearling steers (3 pens of 5 steers) during a 90-day trial (November 9, 1978, to February 7, 1979). Rations contained 84% silage and 16% soybean meal supplement on a DM basis.

Results

Visual appraisal indicated that both silages were well preserved, and chemical analyses (Table 17.1)showed similar compositions.

Feeding results are shown in Table 17.2. Rate and efficiency of gain were slightly better for the Silo-Guard forage sorghum silage, but these differences were not statistically significant. The unusually high feed-to-gain ratios were the result of severe winter weather during the last 40 days of the feeding period. Feed-to-gain ratios were approximately 8.3:1 for both silages the first 42 days of the trial.

Silage DM fermentation loss was 8 percentage units higher for the control compared to Silo-Guard (13.3 vs. 5.3% of the DM put into the silo) (Table 17.3). Ensiling temperatures are shown in Table 17.4. Temperature of the Silo-Guard silage averaged 6.0^{o}F cooler (83.5 vs. 89.5 F) than the control silage the first 6 days. Sila-Guard silage had a 3-day advantage in stability when exposed to air on feedout (Table 17.5). Although both forage sorghum silages were relatively stable in air (no heating or molding the first 4 days), the control silage began heating on day 5 compared with day 8 for Silo-Guard silage, and the control lost nearly four times more DM after 6 days (16.0 vs. 4.45%).

Table 17.1. Chemical analyses of control and Silo-Guard forage sorghum silages.

Silage	Dry matter	pH	Crude protein	Lactic acid	Acetic acid	Propionic acid	Butyric acid	ADF-N[a]
	%		% of the DM					
Control	29.0	3.65	6.3	4.69	2.35	.09	.05	29.0
Silo-Guard	29.8	3.69	6.6	4.49	2.06	.16	.01	22.9

[a]ADF-N means acid detergent fiber-nitrogen expressed as a percent of total nitrogen.

[1]Silo-Guard is an enzyme (and its co-factors) product of International Stock Food, Inc., P.O. Box 29, Waverly, NY 14892.

Table 17.2. Performances by yearling steers fed control and Silo-Guard forage sorghum silages.

Item	Forage sorghum silage: Control	Forage sorghum silage: Silo-Guard
Initial wt., lbs.	735	731
Avg. daily gain, lbs.	1.44	1.50
Avg. daily feed, lbs.[a]	20.40	20.33
Feed/lb. of gain, lbs.[a]	14.18	13.65

[a]100% dry matter basis.

Table 17.3. Forage sorghum silage fermentation and spoilage losses.

Silage	DM put into the silo	DM taken out of the silo and fed	DM not fed (spoilage)	DM lost through fermentation
	lbs.	% of the DM put into the silo		
Control	40,000	84.1	2.6	13.3
Silo-Guard	40,800	92.0	2.7	5.3

Table 17.4. Changes in temperature and losses of dry matter during air exposure by forage sorghum silages.

Silage	Day of initial rise above ambient temp.*	Maximum temp,°F	Accumulated temp. above ambient, °F			Loss of DM, %		
			day 3	day 6	day 9	day 3	day 6	day 9
Control	5	89	**	35.1	82.6	5.4	16.0	20.0
Silo-Guard	8	98	**	**	50.0	4.5	4.5	13.1

*A 3°F rise or more.
**No rise in temperature.

Table 17.5. Ensiling temperatures for control and Silo-Guard sorghum silages.[a]

Days post-ensiling	Control	Silo-Guard	Adv.[b]
	°F		
1	83	80	+3
2	88	82.5	+5.5
3	91	86	+5
4	91.5	85	+6.5
6	92	84	+8
8	93	83.5	+9.5
11	89	82.5	+6.5
17	88	83	+5
20	86	82.5	+3.5
23	85.5	82	+3.5
30	84	81.5	+2.5
35	83.5	80	+3.5

[a]Each value is the mean of six thermocouple readings.

[b]Advantage for additive over control (control minus additive).

KSU

Ensila Plus, Sila-lator, and Silo-Guard for Alfalfa Silage[1,2,3]

Keith Bolsen and Harvey Ilg

Experimental Procedure

Four alfalfa silages (34 to 37% DM) were made May 30 and 31, 1979, as follows: 1) no additive (control), 2) 3 ounces of Ensila Plus per ton, 3) 1.0 lb of Sila-lator per ton, and 4) 1.5 lb of Silo-Guard per ton. Silos were opened after 51 days and each was fed to 41 bred, yearling heifers (one pen of 20 and one pen of 21) during a 26-day trial (July 21 to August 16, 1979). All heifers also received 2.0 lbs daily of a grain mix that contained 200 mg of Rumensin for one pen fed each silage and no Rumensin for the other pen. The silages were full-fed so that the two pens (Rumensin or no Rumensin) receiving each silage got approximately the same quantity of feed. Ensiling temperatures, fermentation dry matter losses, and stability when exposed to air were determined for each silage.

Results

The four alfalfa silages appeared to be well preserved, except for the control silage being a darker brown than the other silages. Chemical analyses (Table 18.1) were similar for the four silages.

Feeding results are shown in Table 18.2. Weight change advantages were +21.6 to +24.8 lbs for heifers fed alfalfa silages made with additives compared to those fed control alfalfa silage. The number of heifers losing weight during the 26-day trial was 28, 2, 3, and 9, respectively, for the control, Ensila Plus, Sila-lator, and Silo-Guard silages. Heifers fed control silage had the lowest feed intake throughout the trial.

Alfalfa silage DM losses during fermentation were 5 to 6 percentage units higher for the control silage compared to the three silages made with additives (Table 18.3).

When compared to the control silage, ensiling temperatures during the first 14 days were 9.9°F cooler for Sila-lator silage, 4.2°F cooler for Ensila Plus silage and 2.3°F cooler for Silo-Guard silage (Table 18.5).

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[1]Ensila Plus is an enzyme product of Agrimerica, Inc., 1829 Stanley St., Northbrook, IL 60062.

[2]Sila-lator is a lactobacillus inoculant and enzyme product of Anchor Laboratories, Inc., 2621 North Belt Highway, St. Joseph, MO 64502.

[3]Silo-Guard is an enzyme (and its co-factors) product of International Stock Food, Inc., P.O. Box 29, Waverly, NY 14892.

Stability of the four alfalfa silages when exposed to air on feedout is shown in Table 18.4. All were highly stable until day 9 when Sila-lator silage was the first to show initial temperature rise. Silo-Guard silage heated on day 11; control and Ensila Plus silages, on day 19.

Table 18.1. Chemical analyses of control, Ensila Plus, Sila-lator, and Silo-Guard alfalfa silages.

Silage	Dry matter	pH	Crude protein	Lactic acid	Acetic acid	Propionic acid	Butyric acid
	%		% of the DM				
Control	37.2	4.57	15.2	5.90	.89	.10	trace
Ensila Plus	36.1	4.59	15.3	5.92	.82	.11	trace
Sila-lator	36.1	4.69	15.1	4.93	.90	.10	trace
Silo-Guard	36.4	4.70	16.2	6.14	1.05	.12	trace

Table 18.2. Weight change and feed intake by heifers fed the four alfalfa silages with or without Rumensin.

	Alfalfa silage				Rumensin	
Item	Control	Ensila Plus	Sila-lator	Silo-Guard	no	yes
Initial wt., lbs.	785	789	786	778	774	795
Final wt., lbs.	775	804	801	790	780	804
Avg. wt. change, lbs.	-10.0	+14.6	+14.8	+11.6	+ 5.6	+ 9.9
Avg. daily feed, lbs.[1]	13.05	15.16	16.06	14.79	14.81	14.72

[1]100% dry matter basis.

Table 18.3. Alfalfa silage fermentation and spoilage losses.

Silage	DM put into the silo	DM taken out of the silo and fed	DM not fed (spoilage)	DM lost through fermentation
	lbs.	% of the DM put into the silo		
Control	16,900	84.6	8.5	6.9
Ensila Plus	16,740	90.0	7.2	2.8
Sila-lator	15,780	90.4	6.5	3.1
Silo-Guard	14,260	89.7	6.9	3.4

Table 18.4. Changes in temperature and losses of dry matter during air exposure by alfalfa silages.

Silage	Day of initial rise above ambient temp.*	Maximum temp,°F	Accumulated temp. above ambient, °F			Loss of DM, %		
			day 7	day 14	day 20	day 7	day 14	day 20
Control	19	77	**	**	8	4.1	4.7	6.3
Ensila Plus	19	75	**	**	12	1.8	2.1	3.3
Sila-lator	9	94	**	74	190	<1.0	6.7	20.4
Silo-Guard	11	99	**	74	150	<1.0	2.0	10.3

*A 3°F rise or more.
**No rise in temperature.

Table 18.5. Ensiling temperatures for alfalfa silages.[a]

Days post-ensiling	Control	Ensila Plus	Adv.[1]	Sila-lator	Adv.[2]	Silo-Guard	Adv.[3]
	°F						
1	84.5	79.5	+5	75	+9.5	79.5	+5
2	88.5	84.5	+4	75.5	+13	85	+3.5
4	90.5	87.5	+3	77.5	+13	88.5	+2
6	90.5	87.5	+3	81	+9.5	90	+0.5
9	91.5	88.5	+3	83	+8.5	90.5	+1
14	92.5	85.5	+7	81.5	+11	91	+1.5
20	93.5	85.5	+8	82	+11.5	91	+2.5
25	93	84.5	+8.5	83	+10	92	+1
35	89.5	81.5	+8	81	+8.5	88.5	+1
45	90.5	81	+9.5	81	+9.5	89.5	+1

[a]Each value is the mean of six thermocouple readings.
[1,2,3]Advantage for additive over control (control minus additive).

Cold-flo[R], Sila-bac[R], and Silo-Best for Corn Silage[1,2,3]

Keith Bolsen, Harvey Ilg, and Jack Riley

Experimental Procedure

Four corn silages (41 to 46% DM) were made August 23 to 26, 1978; treatments were: 1) no additive (control), 2) 8.16 lbs of Cold-flo ammonia per ton, 3) 1.0 lb of Sila-bac per ton, and 4) 1.0 lb of Silo-Best per ton. Silos were opened after 139 days and each was full-fed to 15 heifer calves (3 pens of 5 calves) during a 112-day trial (January 12 to May 4, 1979). The complete-mixed rations contained 88% silage and 12% supplement (Table 19.1). Control silage was supplemented with soybean meal for one group of heifers and urea for another group (urea supplying 33% of the total ration crude protein equivalent). The Cold-flo silage was fed with a milo supplement with no additional crude protein added. Sila-bac and Silo-Best silages were supplemented with soybean meal.

Results

Visual appraisal of the silages showed all were well preserved, and differences in chemical analyses (Table 19.2) were relatively small. Cold-flo silage had the highest pH (4.33) and lactic acid (6.39%), and acid detergent fiber-nitrogen was lowest for Sila-bac silage (7.6% of total nitrogen).

Feeding results are shown in Table 19.3. Heifers fed control corn silage + SBM or Sila-bac corn silage had similar performance. Those fed Silo-Best silage had the same daily gain as those fed control silage + SBM, but the latter consumed about 5% less silage. Cold-flo corn silage reduced gains 5% and efficiency 9% compared with control corn silage + SBM, but calves fed Cold-flo silage or control silage + urea had similar performance. Cold-flo silage averaged 11.1% crude protein, which indicates that only about 50% of the Cold-flo nitrogen applied to the fresh crop was in the silage when fed. The relatively high DM content (44%) of the fresh crop probably explains the relatively low recovery of Cold-flo nitrogen.

Each additive reduced fermentation DM losses approximately 3 percentage units (Table 19.4). Ensiling temperatures showed that Cold-flo sharply

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[1]Cold-flo[R] is a non-protein nitrogen product of USS Agri-Chemicals, Division of United States Steel, P.O. Box 1605, Atlanta, GA 30301.

[2]Sila-bac[R] is a lactobacillus inoculant product of Pioneer Hi-Breds International, Inc., Microbial Products Division, 3930 SW Macadams, Portland, OR 97201.

[3]Silo-Best is an enzyme product of Cadco, Inc., 10100 Douglas Ave., Des Moines, IA 50322.

lowered temperatures after day 2; Sila-bac kept temperatures 2 to 10°F below control after day 1; and Silo-Best silage had a lower maximum temperature than control silage (109.5 vs. 116 F), but average temperature of Silo-Best silage the first 35 days was slightly higher than the control silage temperature (Table 19.5).

Stability of the four corn silages when exposed to air on feedout is shown in Table 19.6. Sila-bac silage was more stable than control silage; Cold-flo and Silo-Best silages were not. Temperatures did not rise, and no spoilage was observed in either the control or Sila-bac silages the first 8 days; DM losses were still about 2.7 and 4.4% on days 3 and 8, respectively. Silo-Best silage had initial temperature rise on day 2 compared with day 7 for Cold-flo silage, but Cold-flo lost more DM at day 8 (13.31 vs. 10.38%) and day 17 (25.86 vs. 16.45%) than Silo-Best.

Table 19.1. Composition of supplements fed with the corn silages.

Ingredient	Corn silage		
	Control (SBM), Sila-bac and Silo-Best	Control (urea)	Cold-flo
	lbs. per ton		
Milo, rolled	147	1562	1650
Soybean meal	1690	---	156
Urea	---	238	---
Tallow	20	20	20
Salt	42	42	42
Dicalcium phosphate	77	120	112
Limestone	6	---	---
Trace minerals	5	5	5
Vitamin A[a]	3	3	3
Aureomycin[b]	10	10	10

[a]Added to supply 30,000 IU of vitamin A per heifer daily.

[b]Added to supply 70 mg of aureomycin per heifer daily.

Table 19.2. Chemical analyses of control, Cold-flo, Sila-bac, and Silo-Best corn silages.

Silage	Dry matter	pH	Crude protein	Lactic acid	Acetic acid	Propionic acid	Butyric acid	ADF-N[a]
	%		% of the DM					
Control	41.9	4.00	8.68	4.99	2.20	.11	.04	9.6
Cold-flo	44.1	4.33	11.08	6.39	2.11	.07	trace	8.5
Sila-bac	44.4	3.98	8.70	4.88	2.83	.13	trace	7.6
Silo-Best	46.0	4.12	8.73	4.63	1.96	.13	trace	9.9

[a]ADF-N means acid detergent fiber-nitrogen expressed as a percent of total nitrogen.

Table 19.3. Performances by heifer calves fed control, Cold-flo, Sila-bac, and Silo-Best corn silages.

Item	Corn silage				
	Control				
	+SBM	+urea	Cold-flo	Sila-bac	Silo-Best
Initial wt., lbs.	429	430	426	433	432
Avg. daily gain, lbs.	2.15	2.01	2.04	2.15	2.15
Avg. daily feed, lbs.[1]	15.60	16.51	16.20	15.91	16.44
Feed/lb. of gain, lbs.[1]	7.28[a]	8.21[d]	7.93[cd]	7.41[ab]	7.68[bc]

[1]100% dry matter basis.

[a,b,c,d]Values with different superscripts differ significantly (P<.05).

Table 19.4. Corn silage fermentation and spoilage losses.

Silage	DM put into the silo	DM taken out of the silo and fed	DM not fed (spoilage)	DM lost through fermentation
	lbs.	% of the DM put into the silo		
Control	57,100	88.7	2.8	8.5
Cold-flo	50,260	91.5	4.5	4.0
Sila-bac	51,500	91.7	3.3	5.0
Silo-Best	49,450	91.3	4.0	6.3

Table 19.5. Ensiling temperatures for the four corn silages.[a]

Days post-ensiling	Control	Cold-flo	Adv.[1]	Sila-bac	Adv.[2]	Silo-Best	Adv.[3]
				°F			
1	106	107	-1	110	-4	109.5	-3.5
2	116	110.5	+5.5	106	+10	108	+8
3	113	106	+7	106	+7	109	+4
4	113	99	+14	105	+8	108.5	+4.5
5	110	86.5	+23.5	104.5	+5.5	108	+2
6	105	85	+20	104	+1	108	-3
8	104	83	+21	101	+3	105	-1
14	102	87	+15	99	+3	103	-1
17	101.5	84	+17.5	98.5	+3	103	-1.5
20	101	84	+17	97.5	+3.5	102.5	-1.5
24	100	76	+24	94.5	+5.5	100.5	-0.5
30	97	70	+27	93.5	+3.5	100	-3
35	95	71	+24	91.5	+3.5	96	-1

[a]Each value is the mean of six thermocouple readings.
[1,2,3]Advantage for additive over control (control minus additive).

Table 19.6. Changes in temperature and losses of dry matter during air exposure by corn silages.

Silage	Day of initial rise above ambient temp.*	Maximum temp, °F	Accumulated temp. above ambient, °F			Loss of DM, %			
			day 8	day 11	day 17	day 3	day 8	day 11	day 17
Control	9	93	**	54.8	212.3	2.9	4.3	9.1	21.0
Cold-flo	7	125	25.0	166.3	332.3	2.5	11.2	13.3	25.9
Sila-bac	15	85	**	**	55.0	2.6	4.5	4.5	9.6
Silo-Best	2	117	140.6	197.3	307.3	5.8	9.4	10.4	16.5

*A 3°F rise or more.
**No rise in temperature.

Lasalocid[1] or Rumensin[2] to Prevent Lactic Acidosis in Cattle

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E. E. Bartley, and S. J. Galitzer

Summary

Lasalocid or Rumensin (monensin) protected cattle gorged with grain from lactic acidosis. Both lasalocid and monensin prevented the decrease in rumen and blood pH and increase in rumen and blood lactic acid (D(-) isomer) usually associated with lactic acidosis. Lasalocid appears more effective in preventing acidosis than monensin.

Introduction

Acidosis, which results from eating too much grain, stems from increased lactic acid (particularly the D(-) isomer) in ruminal fluid and blood, which reduces the pH of the ruminal fluid, blood, and urine.

Acidosis may occur at any time. Cattle are particularly vulnerable when started on feedlot rations or when environmental or other stresses reduce their feed intake so they later eat too much. The economic loss due to acidosis is due to decreased feed consumption, reduced weight gain, poor feed efficiency, and occasionally death.

No effective prevention for lactic acidosis is yet known. The only available method is to switch to high-grain rations gradually and to prevent interruptions in feeding schedules.

The two major lactic acid-producing bacteria of the rumen, *Streptococcus bovis* and *Lactobacillus* species, are directly responsible for the disorder. Hence, a logical approach to control acidosis is to prevent their proliferation. We tested the effects of two polyether antibiotics, monensin and lasalocid, on the lactic acid bacteria of the rumen and as a way to prevent lactic acidosis in cattle.

Experimental Procedure

The sensitivities of the major lactic acid-producing and acid-using rumen bacteria to monensin and lasalocid were determined. Pure cultures were inoculated into culture media containing various concentrations of the antibiotics. Growth was observed by measuring turbidity. The minimum inhibitory concentration was the lowest concentration of the antibiotic in

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[1]A product of Hoffman-LaRoche Inc., Nutley, N.J. Lasalocid is approved for poultry, but not for ruminants.

[2]A product of Elanco Products Co., Indianapolis, Ind.

which there was no measurable bacterial growth.

Next, we conducted an in vitro fermentation study to test the effects of lasalocid and monensin on lactic acid production from glucose. The antibiotics were added at 0 (control) and 6 ppm concentration. Six ppm in vitro is equivalent to 30 g of antibiotic per ton of feed. We anaerobically incubated 100 ml of strained rumen fluid from a cow adapted to an all-roughage ration with an equal amount of mineral buffer and 20 g glucose and took samples at 3, 6, 9, and 12 h of incubation to determine pH and lactic acid.

Four rumen-fistulated cattle (body weight from 650 to 950 lb) were used for acidosis studies. The animals were adapted to a hay ration, and monensin or lasalocid was fed at 600 mg/1000 lb weight per day[3] for 7 days before acidosis was induced. Four trials were conducted, each consisting of 3 treatments; control (no antibiotic), lasalocid, or monensin. The interval between trials ranged from 2 to 3 weeks.

Two samples (controls) of rumen fluid and blood were collected before inducing acidosis. Then 25 lb ground corn per 100 lb body weight was added via rumen fistula. Rumen fluid and blood samples were obtained at 8, 12, 16, 24, 30, 36, and 48 h after the rumens were gorged; samples were analyzed for pH and L(+) and D(-) lactic acid.

Results and Discussion

The two predominant lactic acid-producing bacteria in the rumen, Streptococcus bovis and Lactobacillus species, were inhibited by lasalocid (table 20.1). Monensin was effective against Lactobacillus but not against Streptococcus bovis. However, the three major lactic acid-using bacteria were not sensitive to the antibiotics. Minimum antibiotics required to inhibit the lactic acid-producing bacteria were 5 to 10 times less than found in rumens of cattle fed the antibiotics at 30 g/ton of feed.

Effects of lasalocid and of monensin on lactic acid during in vitro fermentation of glucose is shown in table 20.2. As expected, control samples (no antibiotic) showed a marked decrease in pH and an increase in both L(+) and D(-) lactic acid. Samples treated with either lasalocid or monensin had much less lactic acid. Lasalocid seemed to be more effective than monensin, probably because it inhibits lactic acid-producing bacteria more.

All control animals (without antibiotic) after being gorged showed typical signs of acute acidosis. Rumen pH decreased dramatically as soon as 12 hours (figure 20.1). Rumen pH in monensin-fed cattle decreased dramatically at 24 h and was lower than in lasalocid-fed cattle but higher than the control group. However, lactic acid concentration in monensin-fed cattle was not higher than in the lasalocid-fed group (figure 20.1), which suggests that another acid may be responsible for the decrease in rumen pH in monensin-fed cattle. We are investigating that possibility. Blood of lasalocid-fed and of monensin-fed cattle showed no change in pH, and lactic acid increased

[3] Not cleared by FDA at this dosage. FDA permits feedlot cattle to receive not more than 360 mg Rumensin per head per day.

only slightly (figure 20.2). Rumen contents of control cattle were emptied, usually withing 24 to 36 h after being gorged, when the pH reached 4.4 or below. Rumens of treated animals were emptied at the end of the experiment (48 h).

These experiments suggest that lasalocid or monensin might prevent lactic acidosis in feedlot cattle. Lasalocid appears to be more effective than monensin. Work is in progress to determine the fewest days the antibiotics need to be fed to effectively prevent acidosis.

Table 20.1. Sensitivity of rumen lactic acid-producing and acid-using bacteria to lasalocid or monensin.

Organism	Lasalocid	Rumensin
Lactic acid producers		
Streptococcus bovis	+ (0.75)	-
Lactobacillus ruminis	+ (1.50)	+ (3.0)
Lactobacillus vitulinus	+ (1.50)	+ (1.5)
Lactic acid users		
Megashpaera elsdenii	-	-
Selenomonas lactilytica	-	-
Veillonella alcalescens	-	-

+ = sensitive, - = resistant
Numbers in parentheses indicate minimum concentration in ppm of the antibiotics required for complete inhibition.

Table 20.2. Effect of lasalocid or monensin on pH and L(+) or D(-) lactic acid concentration in rumen fluid incubated _in vitro_ with glucose.

Hours of incubation	pH			L(+) Lactic (mg/ml)			D(-) Lactic (mg/ml)		
	C	L	M	C	L	M	C	L	M
3	6.46	6.74	6.70	.43	.27	.26	.17	.06	.13
6	5.06	6.68	6.18	3.17	.41	.38	.31	.19	.71
9	4.60	6.53	5.50	3.17	.50	.99	.73	.25	.36
12	4.33	5.74	5.13	4.50	.36	1.53	1.24	.49	1.32

C = control (no antibiotic), L = Lasalocid, M = Monensin.

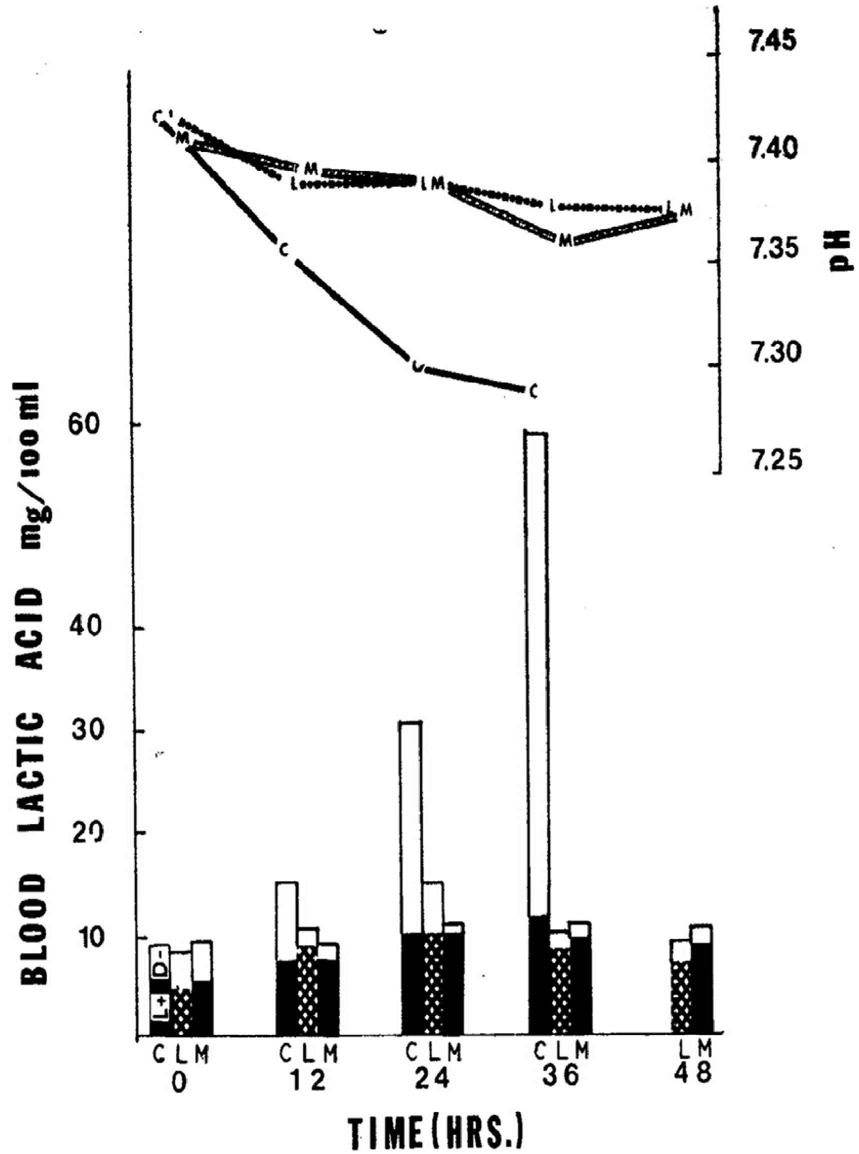

Figure 20.1. Effect of lasalocid or monensin on pH and total lactic acid (L(+) and D(-)) concentration of blood of cattle with induced lactic acidosis. C = control. L = Lasalocid. M = Monensin.

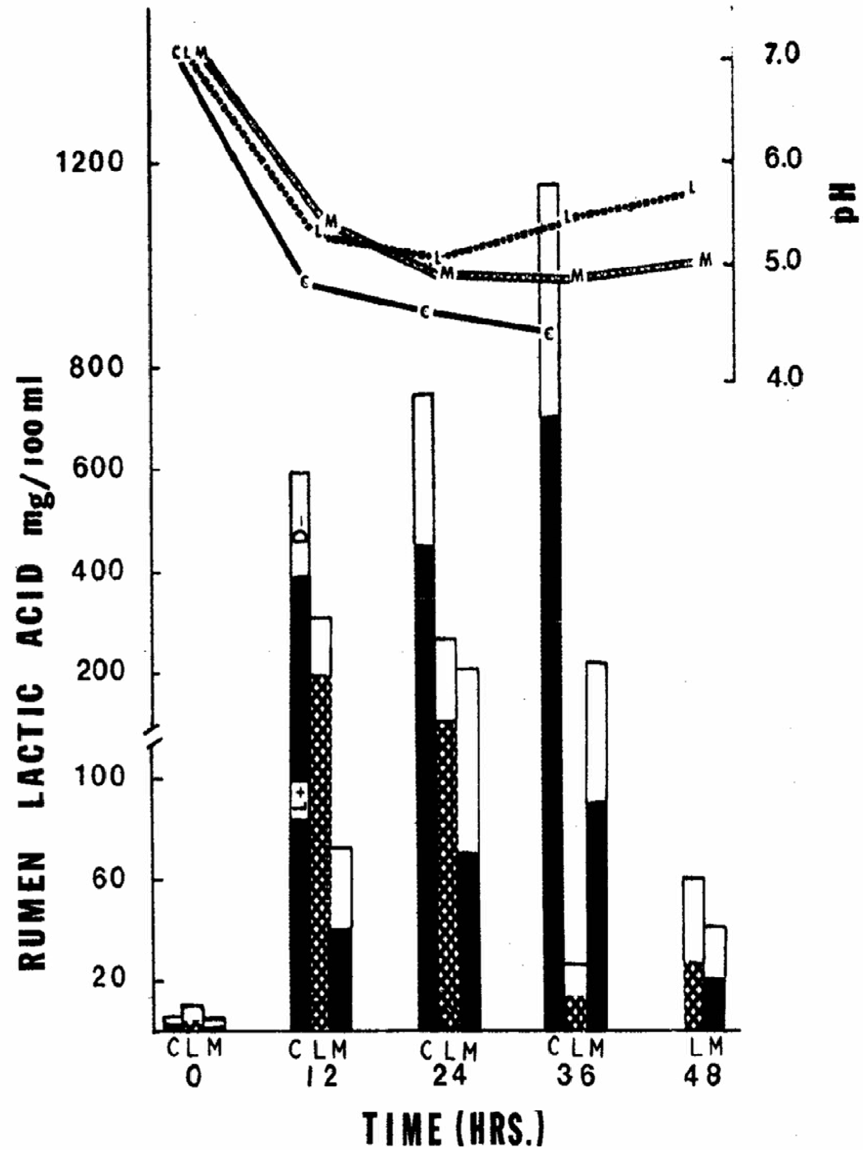

Figure 20.2. Effect of lasalocid or monensin on pH and total lactic acid (L(+) and D(-)) concentration of rumen fluid of cattle with induced lactic acidosis. C = control, L = Lasalocid, M = Monensin.

Grain Dust for Finishing Cattle

Dirk Axe, Harvey Ilg, Keith Bolsen, and Keith Behnke

Summary

Two finishing trials with heifers and steers were conducted to determine the value of grain dust (GD) to replace cracked corn and to compare soybean meal and urea as protein supplements.

Results of the 104-day heifer trial showed that 50% GD supported the least efficient gains. Heifers fed 0 and 25% GD rations had similar performances. In the 75-day steer trial, replacing 12.5 or 25% of the cracked corn in the ration with GD did not affect rate of gain. However, steers fed the GD rations consumed more feed and were less efficient than steers fed the cracked corn, control ration.

In both trials, soybean meal and urea supplements gave similar rates and efficiencies of gain.

Introduction

Grain dust is a problem in the grain marketing industry today. Historically, it has been dumped into rivers, blended in mill feeds, and disposed of in other ways. It is difficult to handle, feed manufacturers are reluctant to use it as a feed ingredient, and it is a dangerous explosive. Chemical analyses of grain dust vary with season, geographic location, grain source, and design of dust collection systems.

Objectives of our trials were to: 1) determine grain dust's value as a replacement for corn in feedlot rations and 2) compare soybean meal and urea as protein sources in grain-dust rations.

Experimental Procedure

Heifer trial: Thirty-six yearling Hereford heifers averaging 672 lb were allotted by weight to individual pens. Six heifers were assigned to each of the six rations. Soybean meal and urea were each fed with 0, 25, and 50% grain dust. The ration contained 80% cracked corn/grain dust, 15% prairie hay, and 5% pelleted supplement. Grain dust replaced corn in the dust rations (table 21.1), and proximate analyses of both are shown in table 21.2. All rations were formulated to contain 11.5% crude protein, and all were mixed and fed free-choice twice daily. The grain dust and supplements were fed as ¼-inch pellets.

Steer trial Sixty yearling steers averaging 816 lb were allotted to 12 pens of 5 steers each. Four pens were assigned to each level of grain

dust: 0, 12.5, or 25%; two pens from each grain dust level received a soybean meal supplement and two pens, a urea supplement. The ration and supplement composition are shown in table 21.3. All rations were formulated to contain 11.2% crude protein.

In both the heifer and steer trials, initial and final weights were taken after animals went 15 hours without feed or water. Final liveweights were then adjusted to a 62% dressing percentage.

Grain dust used in the two trials was provided by Far-Mar-Co Regional Terminal Elevator, Topeka, Ks., and was primarily of corn, milo, and wheat origin.

Results and Discussion

Heifer trial: Performances of all heifers are shown in table 21.4; effect of grain dust, in table 21.5; and effect of protein supplement in table 21.6. Heifers fed 0 and 25% grain dust rations had faster (P<.05) gains than those fed 50% grain dust. Daily feed consumption was not affected by level of grain dust, but the 50% grain dust ration gave the least efficient (P<.05) feed to gain ratio.

Steer trial: Performances of all steers are shown in table 21.7; effect of grain dust, in table 21.8; and effect of protein supplement in table 21.9. Steers fed 0, 12.5, or 25% grain dust rations had similar rates of gain; however, those fed 12.5 or 25% grain dust rations consumed more (P<.05) feed and were approximately 7% less efficient than those fed the control ration.

In neither the heifer nor the steer trial was there an interaction between levels of grain dust and supplemental protein sources. Soybean meal and urea supported similar feedlot performances.

Table 21.1. Ration and supplement compositions for the heifer trial.

	Level of grain dust and source of supplemental protein					
	0%		25%		50%	
Ingredient	SBM	Urea	SBM	Urea	SBM	Urea
	%, dry matter basis					
Cracked corn	80.0	80.0	55.0	55.0	30.0	30.0
Grain dust	---	---	25.0	25.0	50.0	50.0
Prairie hay	15.0	15.0	15.0	15.0	15.0	15.0
Supplement	5.0[a]	5.0[b]	5.0[a]	5.0[b]	5.0[a]	5.0[b]

[a]Soybean meal supplement (pelleted) containing these ingredients in lb/ton: 336.5 ground corn, 1176 soybean meal, 264 limestone, 90 potassium chloride, 12 dicalcium phosphate, 100 salt, 13.2 vitamin A premix (10,000 IU/g), and 8.3 Rumensin premix (60 g/lb).

[b]Urea supplement (pelleted) containing these ingredients in lb/ton: 1258.5 ground corn, 169 urea, 253 limestone, 135 potassium chloride, 45 dicalcium phosphate, 100 salt, 18 magnesium sulfate, 13.2 vitamin A premix (10,000 IU/g), and 8.3 Rumensin (60 g/lb).

Table 21.2. Proximate analyses of the cracked corn and grain dust fed in the heifer trial.

Item	Cracked corn	Grain dust
Dry matter, %	84.86	90.14
	%, dry matter basis	
Ether extract	5.68	6.58
Crude fiber	2.43	9.74
Crude protein	9.86	12.15
Ash	2.22	8.76
Nitrogen-free extract	79.81	62.77

Table 21.3. Ration and supplement compositions for the steer trial.

	Level of GD and source of supplemental protein					
	0%		12.5%		25%	
Ingredient	SBM	Urea	SBM	Urea	SBM	Urea
	%, dry matter basis					
Cracked corn	80.0	80.0	67.5	67.5	55.0	55.0
Grain dust	---	---	12.5	12.5	25.0	25.0
Corn silage	15.0	15.0	15.0	15.0	15.0	15.0
Supplement	5.0[a]	5.0[b]	5.0[a]	5.0[b]	5.0[a]	5.0[b]

[a]Soybean meal supplement containing these ingredients in lb/ton: 765.5 rolled milo, 723 soybean meal, 260 limestone, 108 potassium chloride, 22 dicalcium phosphate, 100 salt, 13.2 vitamin A premix (10,000 IU/g), and 8.3 Rumensin premix (60 g/lb).

[b]Urea supplement containing these ingredients in lb/ton: 1342 rolled milo, 104 urea, 255 limestone, 130 potassium chloride, 38 dicalcium phosphate, 100 salt, 9.5 magnesium sulfate, 13.2 vitamin A premix (10,000 IU/g), and 8.3 Rumensin premix (60 g/lb).

Table 21.4. Performances by heifers fed the indicated six grain dust rations.

Item	0% grain dust SBM	0% grain dust Urea	25% grain dust SBM	25% grain dust Urea	50% grain dust SBM	50% grain dust Urea
No. of heifers	6	6	6	6	6	6
Initial weight, lbs	669	679	675	666	669	673
Final weight, lbs	880	876	876	864	804	790
Avg. total gain, lbs	211	197	202	198	136	118
Avg. daily gain, lbs	2.03	1.89	1.94	1.91	1.31	1.13
Avg. daily feed, lbs[1]						
corn	12.43	12.01	8.78	8.52	4.48	4.58
grain dust	---	---	3.98	3.88	7.46	7.62
supplement	.78	.75	.79	.78	.75	.76
prairie hay	2.33	2.25	2.39	2.33	2.24	2.28
total	15.54	15.01	15.94	15.51	14.93	15.24
Feed/lb of gain, lbs[1]	8.09	8.39	8.43	8.14	11.64	13.84
Dressing percentage	61.67	62.85	62.22	62.24	61.70	58.67

[1]100% dry matter basis.

Table 21.5. Performances by heifers fed 0, 25, or 50% grain dust rations.

Item	0% grain dust	25% grain dust	50% grain dust
No. of heifers	12	12	12
Avg. daily gain. lbs	1.96[a]	1.93[b]	1.22[b]
Avg. daily feed, lbs[1]	15.27	15.73	15.08
Feed/lb of gain, lbs[1]	8.24[b]	8.28[b]	12.74[a]
Dressing percentage	62.26[a]	62.23[a]	60.18[b]

[1]100% dry matter basis.

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

Table 21.6. Performances by heifers fed SBM or urea supplements.

Item	Soybean meal	Urea
No. of heifers	18	18
Avg. daily gain, lbs	1.76	1.65
Avg. daily feed, lbs[1]	15.47	15.25
Feed/lb of gain, lbs[1]	9.3	10.13
Dressing percentage	61.86	61.25

[1]100% dry matter basis.

Table 21.7. Performances by steers fed the indicated six grain dust rations.

Item	0% grain dust		12.5% grain dust		25% grain dust	
	SBM	Urea	SBM	Urea	SBM	Urea
No. of steers	10	10	10	10	10	10
Initial weight, lbs	816	818	816	845	813	815
Final weight, lbs	1041	1041	1045	1054	1039	1038
Avg. total gain, lbs	225	223	229	209	226	223
Avg. daily gain, lbs	3.00	2.98	3.06	2.79	3.01	2.98
Avg. daily feed, lbs[1]						
corn	15.91	16.55	14.91	14.33	12.23	11.55
grain dust	---	---	2.65	2.57	5.38	5.01
supplement	.96	.98	1.06	1.03	1.08	1.00
silage	3.61	3.67	3.92	3.77	3.95	3.70
total	20.48	21.20	22.54	21.70	22.64	21.26
Feed/lb of gain, lbs[1]	6.82	7.11	7.38	7.81	7.52	7.41
Dressing percentage	59.08	58.28	58.41	59.53	59.02	58.91

[1] 100% dry matter basis.

Table 21.8. Performances by steers fed 0, 12.5, or 25% grain dust rations.

Item	0% grain dust	12.5% grain dust	25% grain dust
No. of steers	20	20	20
Avg. daily gain, lbs	2.99	2.92	3.00
Avg. daily feed, lbs[1]	20.84[a]	22.12[b]	21.95[b]
Feed/lb of gain, lbs[1]	6.96[a]	7.60[b]	7.33[a,b]
Dressing percentage	58.75	58.97	58.97

[1] 100% dry matter basis.

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

Table 21.9. Performances by steers fed soybean meal or urea supplements.

Item	Soybean meal	Urea
No. of steers	30	30
Average daily gain, lbs	3.02	2.92
Average daily feed, lbs[1]	21.88	21.38
Feed/lb of gain, lbs[1]	7.24	7.35
Dressing percentage	58.84	58.96

[1] 100% dry matter basis.

Effects of Location and Crushing Ralgro Implants on Cattle Performance (Summary of Three Trials)[1,2]

Larry R. Corah, Steve D. Plegge, and Gene Francis

Summary

Implanting at an alternate location (in the muscle or fat pad at the base of the ear) or crushing the pellets did not appear to cause side effects or adversely affect animal performance. However, implanting at the alternate location significantly improved (6.6%) average daily gain in all three trials. Based on these and other studies, the recommended location for Ralgro implants is as close to the base of the ear as possible.

Introduction

In recent years, use of anabolic implants has increased dramatically. Efficacy of these compounds for promoting growth in cattle of various weights is well established. Periodically, treated cattle show side effects such as excessive udder development, elevated tail heads, and increased "bulling." The role that improper implanting technique may play in causing such effects has not been studied.

Experimental Procedure

The following three studies were initiated to determine effects of where Ralgro is implanted and whether crushing the pellet produces side effects or influences growth rate. Two Kansas ranchers cooperated. In all three trials, the treatments were:

1. non-crushed - recommended location
2. crushed - recommended location
3. non-crushed - alternate location
4. crushed - alternate location

The recommended implant location was subcutaneous on the backside of the mid part of the ear, one inch from its base. The alternate location was at the point of attachment of the ear. Pellet crushing was accomplished by making a slight indentation of the implant needle. The recommended dosage, 36 mg, was always used.

Initially, all cattle were weighed after 2 to 3 hours off feed and were randomly allotted to eliminate a shrink effect. At the end of the

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[1]Ralgro is a product of the International Minerals and Chemical Corporation, Terre Haute, Ind.

[2]Appreciation is expressed to the cooperating ranchers: Jim Harper, Ashland, Kansas, and David Holbrook, Washington, Kansas, and to County Agents Gary Keeler, Washington County, and Ed Laverty, Clark County, for assisting in data collection.

trial, cattle were weighed in random order. All weights were taken on portable scales that weighed to the nearest 5 lbs. Cooperating producers observed cattle daily for side effects.

Trial 1 (Heifers)

The initial trial was at the Jim Harper ranch near Ashland, Kansas. Cattle were implanted October 11, 1977. The Brahman-cross heifers, grazing on wheat pasture, were weighed after 30 days (November 10). Final weights were taken after 100 days (January 19, 1978). At the end of the trial, udders were subjectively evaluated for possible edema or unusual enlargement.

Results of trial 1 are shown in table 22.1. Crushing the pellet had no significant effect on animal performance. However, heifers implanted at the alternate location gained 3.5% faster (P<.10).

Table 22.1. Results of trial 1.

Treatment			Pounds						Avg. udder
Location	crushed	No.	Starting weight	30-day weight	Wt. gain 30 days	Final wt.	Wt. gain total	ADG trial	development score*
Recommended	No	53	348.4	379.4	31.0	502.9	154.5	1.55	1.3
Recommended	Yes	54	335.4	361.6	26.2	493.4	158.0	1.58	1.28
Alternate	No	53	337.5	370.9	33.4	499.9	162.4	1.62	1.28
Alternate	Yes	53	341.4	374.5	33.1	503.7	162.3	1.62	1.34

* Scoring system for udder development in implanted heifers: 1 = natural development, no abnormalities; 2 = slight abnormality (teat elongation); 3 = abnormal development (teat elongation, some udder development); 4 = extremely abnormal development.

Trial 2 (Heifers)

A second trial at the Jim Harper ranch near Ashland, Ks., started October 28, 1978, with 180 yearling Brahman-cross heifers randomly allotted to the four treatments. After 104 days, the heifers were re-weighed February 9, 1979. They were maintained on a wheat pasture with approximately 1 pound of a liquid protein supplement per head daily. Hay was fed during adverse weather.

Results are shown in table 22.2. Confirming trial 1, crushing the pellet had no adverse effect on average daily gain. Again, heifers implanted at the alternate location gained faster (P<.05) (10.6%) than those implanted at the recommended location. No unusual side effects were noted in any heifer in the trial, although at final weighing, one (in the crushed-recommended location group) showed unusual udder development.

Trial 3 (Steers)

This trial was conducted at the David Holbrook farm near Washington, Ks., with 160 mixed steers averaging 840 pounds randomly assigned to the

four treatments October 27, 1978. After 85 days, the steers were weighed off trial January 20, 1979. The high concentrate feedlot ration shown in table 22.3 was fed during the trial.

Implant crushing had no effect on animal performance. However, implanting at the alternate location resulted in a 0.2 lb/head/day (5.8%) improvement in average daily gain ($P<.05$). Results of trial 3 are shown in table 22.4.

Table 22.2. Results of trial 2.

Treatment	No.	Starting weight	Final weight	Lbs. gained	Avg. Daily gain
Non-crushed, recommended	44*	376.1	487.2	111.1	1.07
Crushed, recommended	44**	375.0	481.1	106.1	1.02
Non-crushed, alternate	45	383.6	499.0	115.5	1.11
Crushed, alternate	45	369.0	491.2	122.2	1.18

*One heifer died.
**One heifer showing noticeable udder development at final weighing.
**One heifer could not be weighed at the end of the trial.

Table 22.3. Ration composition.

Ingredient	% (as fed)
Head chop milo	49.8
High moisture milo (bunker)	25.0
Forage sorghum silage	17.6
Rolled corn	5.0
Supplement[a]	2.6

[a]Supplied 250 mg Rumensin per head daily and contained 16% NPN.

Table 22.4. Influence of implanting technique on performance.

Location status of implant	Treatment 1 Recommended non-crushed	Treatment 2 Recommended crushed	Treatment 3 Alternate non-crushed	Treatment 4 Alternate crushed
No. of steers	37	39	38	37
Avg. initial wt., lbs.	833	848	832	848
Avg. final wt., lbs.	1123	1137	1134	1156
Days fed	85	85	85	85
Avg. daily gain, lbs.	3.41	3.39	3.55	3.62

Factors Influencing Net Income from Steers through Feedlot[1]

R. R. Schalles, K. O. Zoellner, and Keith Long

Summary

Calves that gained rapidly before going into the feedlot continued to gain rapidly on feed and were more profitable to both the cow-calf operator and the feeder. When fed to their genetic potential, large frame, heavy, young cattle were worth more to the cattle industry than light calves.

Introduction

All performance traits vary genetically among cattle, which provides cattlemen opportunities to produce the most profitable type of cattle. This study was to determine traits that most influence net income.

Experimental Procedure

During five years (1974 through 1978), 444 steers from 22 herds were put on feed at the Solomon Valley Feedlot, Inc., Beloit, Kansas. Most of their calves were crossbred, and most had some Continental European breeding. They were about 9 months old and weighed an average of 592 lb. when put on feed (table 23.1). Most were within 60 days of the same age. Rations were the same as those fed commercial cattle in the feedlot. Individual starting and slaughter weights were obtained. Steers were slaughtered at the Dubuque Packing Plant, Mankato, Ks., when estimated to grade choice. Carcass data were collected.

Pre-feedlot production costs were assumed at $200 per head in 1974 through 1977 and $225 per head in 1978. All other costs were actual. Gross income was the actual amount received from the packing plant. Starting value was determined from the USDA Livestock Market News weekly summary of Kansas City prices for each weight calf. That enabled us to evaluate three production systems: 1) Retained ownership from birth through slaughter, 2) purchased feeder calves through slaughter, 3) producer selling feeder calves.

Results and Discussion

On the average, the steers made a profit each year except 1975-76 when they lost $4.77 per head during the feeding period (table 23.2). If the

[1]Data from the Commercial Cattle Improvement Program sponsored by Guarantee State Bank and Trust Co., Beloit, Ks., and Kansas State University Cooperative Extension Service.

calves had been sold as feeders, they would have made a profit each year except 1974-75 when the loss would have been $33.20 per head.

In all systems, growth was the most important factor influencing net income (highest correlation, table 23.3)(slaughter weight with retained ownership, ADG during feeding with purchased calves, and weight when feeder calves were sold). Because cattle were slaughtered at an average grade of low choice, carcass traits had little influence on net income. Framier cattle (as indicated by shoulder height) were more profitable, probably because of the relationship between shoulder height and other growth traits (table 23.4).

Calves that grew slowly before going on feed continued slow growth in the feedlot. Fast growing, framier cattle had more desirable carcasses with less fat and larger loin eyes. Steers were slaughtered on expected grade, with 77.7% grading low choice or better. Most of the remainder graded high good.

Steers in this study were growthier than average cattle. They were put on feed young (9 months) weighing nearly 600 lb., fed for rapid gains (3.04 lb/day) for a long period (187 days). They were slaughtered young (15 months) and produced very desirable carcasses (705 lb, yield grade 2.9, 77.7% choice). While most cattle were losing money, they produced profits both as feeder calves and in the feedlot.

Table 23.1. Means and standard errors of calves fed.

Trait	Mean ± Standard error*
Weight on feed (lb)	592±84
Age on feed (days)	275±30
Starting weight per day age (lb)	2.17±.29
Shoulder height after 100 days feed (in.)	44±2
Days fed	187±19
ADG during feeding (lb)	3.04±.44
Slaughter weight (lb)	1155±107
Carcass weight (lb)	705±71
Loin eye area (in^2)	12.5±1.5
Backfat (in.)	0.41±.15
Yield grade	2.9±.6
Quality grade	Ch^-±1/3 grade
Starting production cost $	204±9
Starting market value $	245±80
Feed cost $	206±24
Other cost $	21±2
Net income on feed $	70±89

*See the front page for meaning of standard error.

Table 23.2. Average net income per head.

Year	Production system: Retained ownership to slaughter	Purchased feeders to slaughter	Sold as feeders
1974-75	$ 106.75	$ 158.68	$ -33.20
1975-76	- 2.21	- 4.77	24.00
1976-77	14.75	3.32	22.07
1977-78	175.93	123.58	41.03
1978-79	281.43	73.18	219.64
Average	$ 115.33	$ 70.80	$ 54.71
Time owned, mo.	15.3	6.2	9.1

Table 23.3. Correlations among performance traits and net income.

Traits	Retained ownership to slaughter	Purchased feeders to slaughter	Sold as feeders
Weight on feed	0.53	0.05	0.98
Age on feed	0.14	-0.08	0.43
Weight/day age on feed	0.42	0.09	0.61
Shoulder height	0.44	0.15	0.58
ADG during feeding	0.51	0.52	----
Slaughter weight	0.67	0.40	----
Slaughter weight/day age	0.51	0.35	----
Days on feed	-0.28	-0.01	----
Loin eye area	0.34	0.20	----
Backfat	-0.08	-0.05	----
Yield grade	-0.07	-0.04	----
Quality grade	0.09	0.15	----

Table 23.4. Correlation among performance traits.

Traits	Weight on feed	Age on feed	Shoulder height	Slaughter weight	Wt/day age on feed	ADG during feed	Wt/day age at slaughter	LEA	BF	YG
Age on feed	0.45	1.00								
Shoulder height	0.63	0.18	1.00							
Slaughter weight	0.71	0.17	0.67	1.00						
Weight/day of age on feed	0.72	-0.34	0.51	0.61	1.00					
ADG during feed	0.26	-0.08	0.43	0.75	0.32	1.00				
Weight/day of age at slaughter	0.52	-0.37	0.54	0.80	0.83	0.78	1.00			
Loin eye area (LEA)	0.38	0.01	0.28	0.51	0.39	0.34	0.44	1.00		
Backfat (BF)	-0.08	0.07	-0.15	-0.22	-0.16	-0.25	-0.26	-0.36	1.00	
Yield grade (YG)	-0.04	0.10	-0.07	-0.15	-0.15	-0.20	-0.22	-0.72	0.77	1.00
Quality grade (QG)	-0.05	0.05	-0.13	-0.10	-0.11	-0.16	-0.16	-0.26	0.31	0.33

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Company and brand names are used only for easier communications. They imply no preference or endorsement.

PLANNING FOR THE FUTURE

Weber Hall is splitting at the seams. Since its doors opened in 1957, undergraduate enrollment has increased more than four-fold; graduate student enrollment more than five. Enrollment in some courses has increased over ten times. Meats and slaughtering facilities are outdated, inadequate, and barely meet federal meat inspection. Something must be done.

Plans for expanding and renovating Weber Hall are being developed. We think it's a sound investment for the future. If Kansas is to lead in the livestock and meat industry of the future, she must train her youth and broaden her research capabilities. Renovating and expanding Weber Hall will help Kansas maintain her leadership.

Funds generated by the Livestock and Meat Industry Council, Inc. (LMIC) have helped accomplish many teaching and research goals. The Council is a non-profit, educational and charitable corporation that receives, pools and distributes funds that play an important role in the Department of Animal Sciences and Industries teaching, research and extension programs.

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

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

Officers and directors of the LMIC are: W. C. Oltjen, president and chairman; Henry Gardiner, immediate past president; Wayne Rogler, vice president; Calvin Drake, executive vice president; Fred Germann, secretary; Gene Watson, treasurer; and Earl Brookover, Charles Cooley, Orville Burtis Jr., Walter Lewis, A. G. Pickett and A. D. Weber, Linton Lull and Scott Chandler.

The Council's individual projects, related to teaching as well as research, are too numerous to mention. Recently, LMIC funded a project to develop an automated beef grading device.

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

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

Agricultural Experiment Station, Kansas State University, Manhattan 66506

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Publications and public meetings by the Kansas Agricultural Experiment Station are available and open to the public regardless of race, color, national origin, sex, or religion.

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