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INVESTIGATION OF PRESLAUGHTER FACTORS THAT MAY INCREASE THE INCIDENCE OF DARK CUTTING BEEF

by

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SUMMARY

Information on feeding and preslaughter management was collected for 31 groups of cattle to investigate factors that may influence the incidence of dark cutting beef. Mixing of cattle from different feeding pens for 16 to 40 hr prior to slaughter, which resulted in resocialization and increased activity, increased (P<.05) the incidence of dark cutters. Not mixing cattle from different home feeding pens or slaughtering cattle within 15 hr of mixing them appeared to minimize muscle glycogen depletion and the incidence of dark cutters.

INTRODUCTION

Dark cutting beef is characterized by high postmortem pH, increased water binding capacity, a sticky texture, and a dark color resulting from muscle glycogen depletion prior to slaughter. Dark cutting beef often is rejected by consumers, and carcasses are discounted severely. The incidence of dark cutters in finished cattle varies greatly and is associated with time of year and preslaughter stress. The objective of this study was to investigate the influence of management practices and preslaughter events that may contribute to an increased occurrence of dark cutters.

PROCEDURES

County Extension agents in southwest Kansas collected information on 31 cattle groups from different feed yards during September, October, and November. Survey data forms included animal characteristics, diet, implants used, feed additives used, home pen, holding pen, and loading observations. Animal characteristics included number received; in-pay weight; number of bullers removed; number of chronics removed; death loss; days on feed; number sold from home pen; number sold from other pen; out-pay weight; frame (small, medium, and large); age (calf-fed, short-yearling, long-yearling); breed type (British and British cross, British/Exotic cross, Exotic and Exotic cross, low percentage Brahman, high percentage Brahman, and Holstein); and sex (steer, heifer, heiferette, and bullock). Feeding pen observations included dimensions, last feeding day and time, day and time removed from pen, and behavior/activity observations. Holding pen observations included dimensions, water availability, amount and type of activity by the cattle, and other observations. Loading observations included day and time of loading, activity, and other observations. At the packing plant, data collected for 28 of these cattle groups included day and time of arrival; slaughter day and time; net live weight; hot carcass weight; weight distribution (<525, 525-735, 735-950, and >950); sex (steers, heifers, heiferettes, cows, and bulls/stags); quality grade (Prime, Choice, Select, other); yield grades (1, 2, 3, 4, 5); number with grubs; number condemned; number discounted; number of dark cutters; and number bruised/trimmed.

From this information, data were summarized and plots were constructed to observe factors that may influence the percentage of dark cutters. Limited observations for many traits made analysis and conclusions inconclusive. However, the practice of mixing cattle from different home feeding pens in holding pens for a period of time greater than 15 hr prior to slaughter appeared to consistently increase the incidence of dark cutters. We had data on pen mixing and holding time for 17 groups. These groups then

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were analyzed as a 2 x 2 factorial treatment arrangement with mixed and not mixed as one factor, and two mixing times as the other (1-15 hr and >15 hr). Least squares means were determined, and a probability value of less than .05 was considered significant.

RESULTS AND DISCUSSION

Selected carcass traits from cattle mixed during holding for slaughter and cattle not mixed as well as the influence of hours removed from the home pens are presented in Table 1. Cattle that were mixed and slaughtered 16-40 hr after the initial mix had a higher ($P<.05$) incidence of dark cutters compared to cattle either not mixed or mixed for less than 15 hr. This indicates that at least 15 hr are needed for the stress associated with the resocialization and increased activity from mixing of cattle to deplete muscle glycogen to levels that would result in the dark cutting condition. Although not significant ($P>.05$), cattle mixed for 16-40 hr prior to slaughter appeared to have a higher incidence of bruised carcasses that required some trimming. This suggests that increased activity from mixing might result in increased bruising and incidence of carcass trimming.

These results suggest that to minimize dark cutters, cattle from different pens should not be commingled. If cattle must be commingled prior to slaughter, the time should be minimized.

Table 1. Influence of mixing or not mixing of cattle from different pens and hours removed from home pens prior to slaughter on selected carcass traits.

	Not Mixed		Mixed		
Trait	1-15 hr	16-30 hr	1-15 hr	16-40 hr	SD[1]
No. of lots	5	4	4	4	
Prime/Choice, %	34.6	31.4	40.8	37.6	11.9
Select, %	64.4	67.3	58.4	56.1	11.9
Other quality grade, %[2]	.62	.42	.58	.33	.53
Yield grade 1-2, %	70.8	54.5	54.2	52.7	10.1
Yield grade 3, %	25.7	43.6	40.6	44.6	8.7
Yield grade 4-5, %	1.5	4.1	5.1	2.7	3.4
Dark cutter, %	.54[a]	.79[a]	.34[a]	5.97[b]	1.95
Bruised/trimmed, %[3]	11.0	7.7	11.2	14.9	9.4

[1] Pooled standard deviation of the observation; standard error (SE) = SD/$\sqrt{N}$.
[2] Other includes no rolls (standard, C, D or E bone maturity, stags/bulls.
[3] Percent of carcasses that required some trim.
[a,b] Means in the same row with different superscripts are different ($P<.05$).

Southwest Research-Extension Center

WEATHER-RELATED FACTORS AFFECTING THE OCCURRENCE OF DARK CUTTING BEEF

by

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SUMMARY

The objective of this study was to investigate the influences of time of year and weather-related conditions on the incidences of dark cutting beef. The incidences of dark cutting beef carcasses were collected from random lots and pooled by day, providing 1496 observations from four commercial packing facilities. Observations were divided into 2-month periods. The highest ($P < .05$) incidence of dark cutters occurred during the July / August period when the high and low temperatures on the day before slaughter were highest ($P < .05$). The lowest ($P < .05$) incidence of dark cutters occurred during November / December, January / February, and March / April, which had the lowest high and low temperatures on the day before slaughter. Within the January / February period, cattle slaughtered when the low temperature on the day before slaughter was below 5°F had ($P < .05$) a higher incidence of dark cutters than cattle slaughtered when the low temperature before slaughter was greater than 22°F. In contrast, during the November / December period, cattle tended ($P < .08$) to have a higher incidence of dark cutters when the high temperature on the day before slaughter was greater than 58°F compared to either high temperatures of 23 to 40°F or temperatures less than 5°F. Also during this period, when the change in temperature the day before slaughter was over 35°F, cattle tended ($P < .07$) to have a higher incidence of dark cutters. While some month periods appeared to have differences for high temperature, low temperature, change in temperature, and occurrence of precipitation on the day before slaughter, significant differences ($P < .10$) were not detected partially because of the highly variable occurrence of dark cutters. These data suggest that weather-related conditions may be among the numerous factors involved in the depletion of muscle glycogen and incidence of dark cutters. However, weather-related conditions may only potentiate the incidence and must be coupled with numerous other factors such as other environment, management, and genetic conditions.

INTRODUCTION

Dark cutting beef carcasses are discounted severely and often rejected by consumers. Dark cutting beef is characterized by a high postmortem muscle pH, increased water binding capacity, a sticky texture, and a dark color. The incidence of dark cutters varies greatly and is associated with preslaughter stress that depletes muscle glycogen. Time of year and weather conditions often have been linked with the incidence of dark cutters. The objective of this study was to investigate the influence of time of year and weather conditions on the incidence of dark cutting beef.

PROCEDURES

Carcass data were collected from four commercial slaughter facilities in 1989 and 1990. Data were collected from two random lots of cattle per 8-hour kill shift. The carcass data for the lots from each day within a plant were pooled to obtain 1496 observations. The percentage of dark cutters for steers vs heifers was recorded. Additional information and detailed carcass data were reported last year (Kreikemeier et al, Cattle Feeders' Day 1996, Report of Progress 773). Data were grouped into six periods; Jan-Feb, Mar-Apr, May-Jun, Jul-Aug, Sep-Oct, and Nov-Dec.

Local weather data (high temperature, low temperature, and precipitation) were gathered for each plant site. Previous reports suggest that cattle must be stressed for several hours (minimum of 6-8 hr) preslaughter before dark cutting carcasses occur. In addition, the replenishing of muscle glycogen is a comparitively slow process. Therefore, temperatures (high and low) and precipitation on the day before slaughter were used in the analysis. The high

temperatures (°F; within period) were grouped as follows: <4, 5 to 22, 23 to 40, 41 to 58, 59 to 76, 77 to 94, and > 94°F. The low temperatures were grouped as follows: <4, 5 to 22, 23 to 40, 41 to 48 and > 58°F.

The low temperature group (< 4°F) was selected as the predicted lower critical temperature for feedlot cattle with a winter coat. This is an estimate of the cold temperature at which cattle in the winter would be stressed. The high temperature group was the predicted upper critical temperature (> 94°F) for feedlot cattle with a summer coat. We also calculated the change in temperature as the difference between the high and low temperatures that occurred on the day before slaughter. The differences in daily temperature extremes were grouped into three categories: <17°F, 18-35°F, and >35° F.

Data were analyzed using GLM procedures of SAS. Analyses included plant as a blocking factor and the distribution of steers and heifers as a covariant.

RESULTS AND DISCUSSION

The overall incidence of dark cutting carcasses was .77%, with a maximum occurrence (within day, within plant) of 30.2%. Overall means for each month period are presented in Table 1. The incidence of dark cutters was highest during the period of July/August ($P < .05$). This corresponded with the warmest ($P < .05$) high and low temperatures on the day before slaughter. The incidence of dark cutters was higher ($P < .05$) for the September/October and May/June periods than the March/April, January/February, and November/December periods. It is interesting to note that both May/June and September/October periods had warmer ($P<.05$) high and low temperatures than the three remaining periods.

The average daily change in temperature (high-low temperature) was higher ($P < .05$) during September/October than March/April, November/ December, and January/February. January/February had the lowest ($P< .05$) temperature differential.

Although precipitation was statistically similar ($P > .10$), the spring periods appeared to have higher daily precipitation. These data indicated that weather may be a factor that contributes to or potentiates the preslaughter depletion of muscle glycogen, resulting in an increase the incidence of dark cutters.

To further investigate the relationship of temperature on the incidence of dark cutters, we looked at the effect of high temperature, low temperature, and temperature differential within each of the six slaughter periods. During the July/August period, the incidence of dark cutters was highest (Table 1). During this period, although not significant ($P> .10$), the coolest high temperature (<77°F) on the day before slaughter coincided with the highest incidence of dark cutters (Figure 1). Also in the July/August period, a nonsignificant ($P > .10$) tendency occcurred for the smallest temperature differential to result in a higher incidence of dark cutters (Figure 3). A high amount of variation occurred during this period, indicating that other factors are involved in the incidence of dark cutters. However, the higher incidence of dark cutters during this period suggests that sustained higher temperatures may compromise the level of muscle glycogen and, combined with other influences such as reduced feed intake, may create a higher incidence of dark cutters.

During the November/December period, high temperatures of greater than 58°F tended ($P = .08$) to produce a higher incidence of dark cutters than high temperatures of 23 to 40°F and less than 5°F (Figure 1). Also during this period, when a change in temperature of over 35°F occurred (Figure 3), the incidence of dark cutters tended ($P < .07$) to be higher. These cattle with early winter coats may be more susceptible to greater temperature differentials and warm temperatures during November-December compared to the other time periods. This suggests that cattle during this period are less heat tolerant and would have a lower upper critical temperature at which stress affects muscle glycogen depletion and increases the incidence of dark cutters.

During the January/February period, cattle exposed to low temperatures of less than 5°F (Figure 2) had ($P < .05$) a higher incidence of dark cutters than cattle exposed to low temperatures above 22°F, and cattle exposed to low temperatures of 5 to 22°F tended ($P < .06$) to have a higher incidence of dark cutters than cattle exposed to low temperatures of greater than 22°F. These results suggest that extreme cold temperatures may contribute to depletion of muscle glycogen reserves and potentiate the higher incidence of dark cutters. Other factors that increase the severity of stress in cattle exposed to low temperatures like wind, mud, and precipitation may be involved.

The occurrence of precipitation on the day before slaughter did not influence ($P > .10$) the incidence of dark cutters (Figure 4). However, precipitation can alter effective ambient temperatures and potentially modify critical temperatures and, therefore, animal

Table 1. Influence of month period on percentage of dark cutters and day before slaughter weather.

	Month Period											
	Jan-Feb		Mar-Apr		May-Jun		Jul-Aug		Sep-Oct		Nov-Dec	
Item	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Dark cutter, %	.59[a]	.08	.64[a]	.08	.87[b]	.08	1.38[c]	.11	1.07[b]	.10[b]	.54[a]	.11
High temperature, °F	44.0[a]	.8	61.8[b]	.8	78.9[d]	.8	89.3[e]	1.1	73.9[c]	1.0	43.9[a]	1.1
Low temperature, °F	20.4[b]	.6	35.4[c]	.6	51.8[e]	.6	62.1[f]	.9	45.5[d]	.8	18.3[a]	.8
High-low temperature, °F	23.5[a]	.5	26.4[b]	.5	27.1[bc]	.5	27.2[bc]	.7	28.4[c]	.6	25.6[b]	.7
Precipitation, in./day	.041	.011	.060	.011	.086	.011	.046	.016	.029	.014	.016	.016

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

Fig. 1 Influence of high temperature on the day before slaughter on percentage of dark cutters.

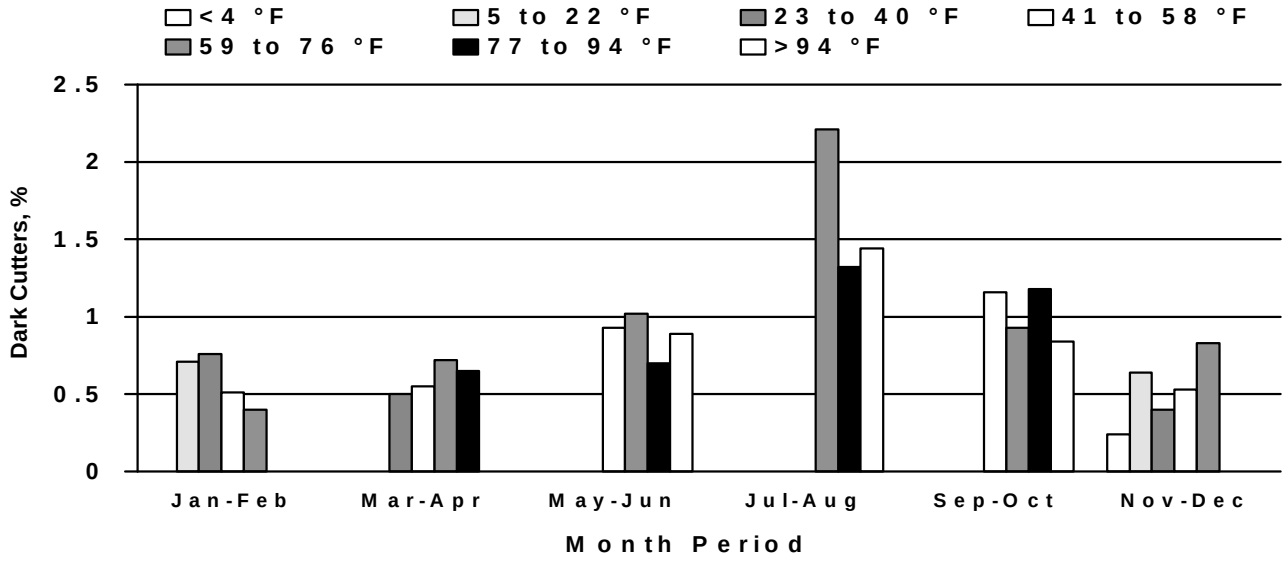


Fig. 2. Influence of low temperature on the day before slaughter on the percentage of dark cutters.

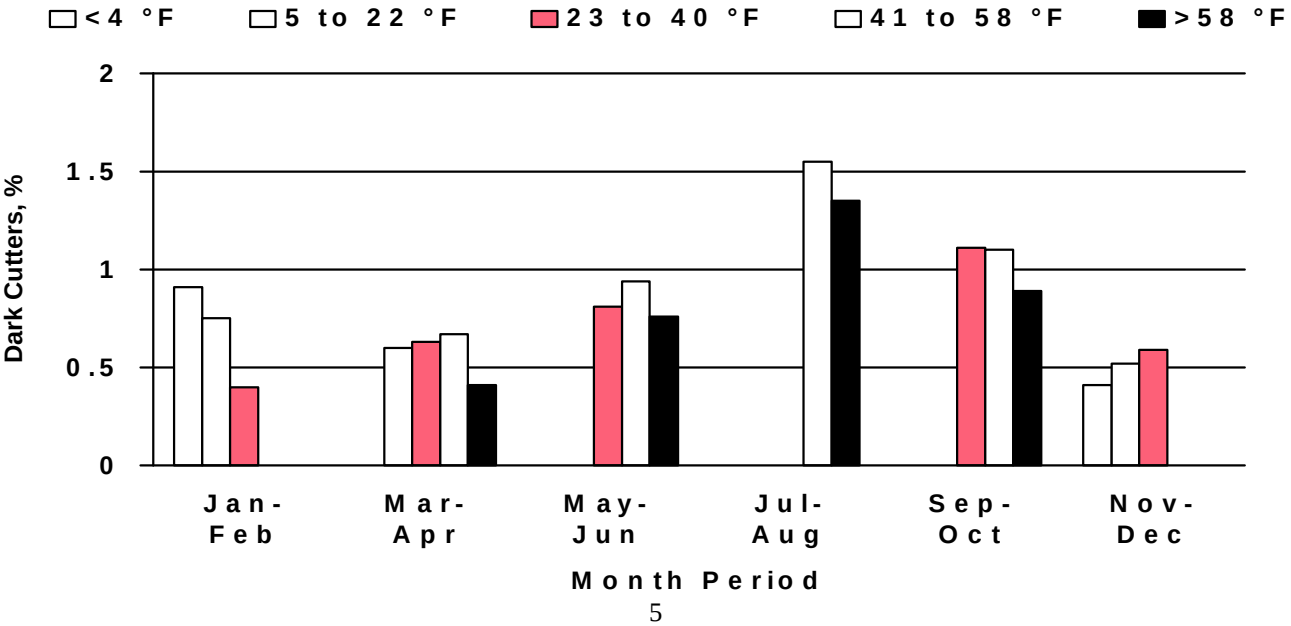


Fig. 3. Influence of change in daily temperature on the day before slaughter on percentage of dark cutters.

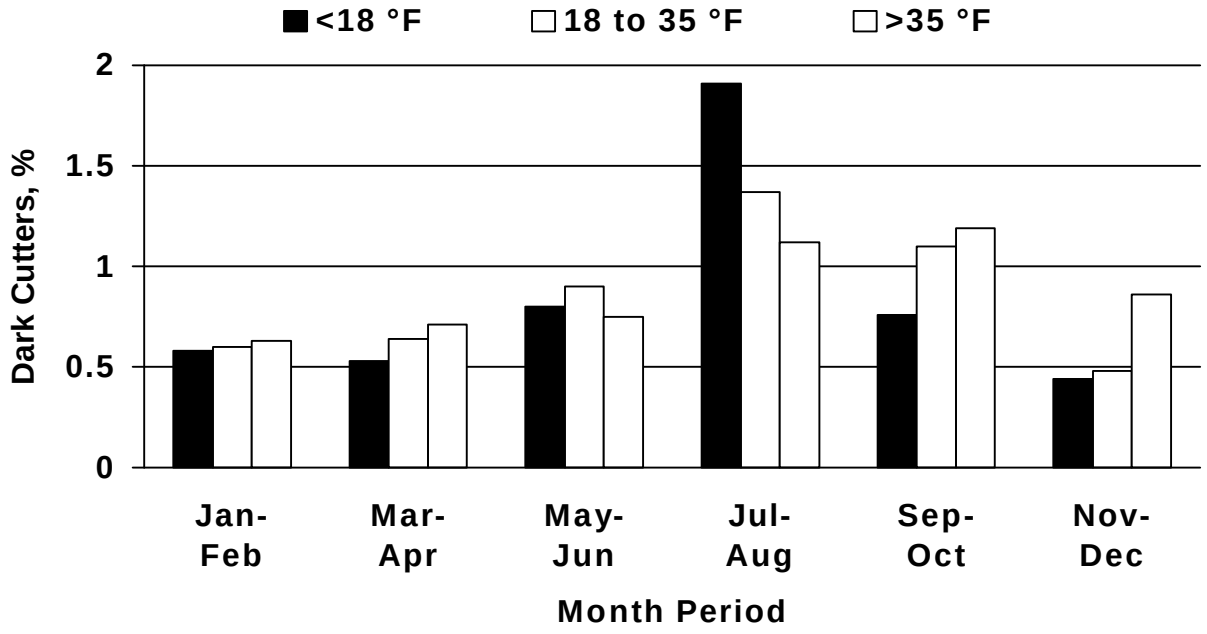
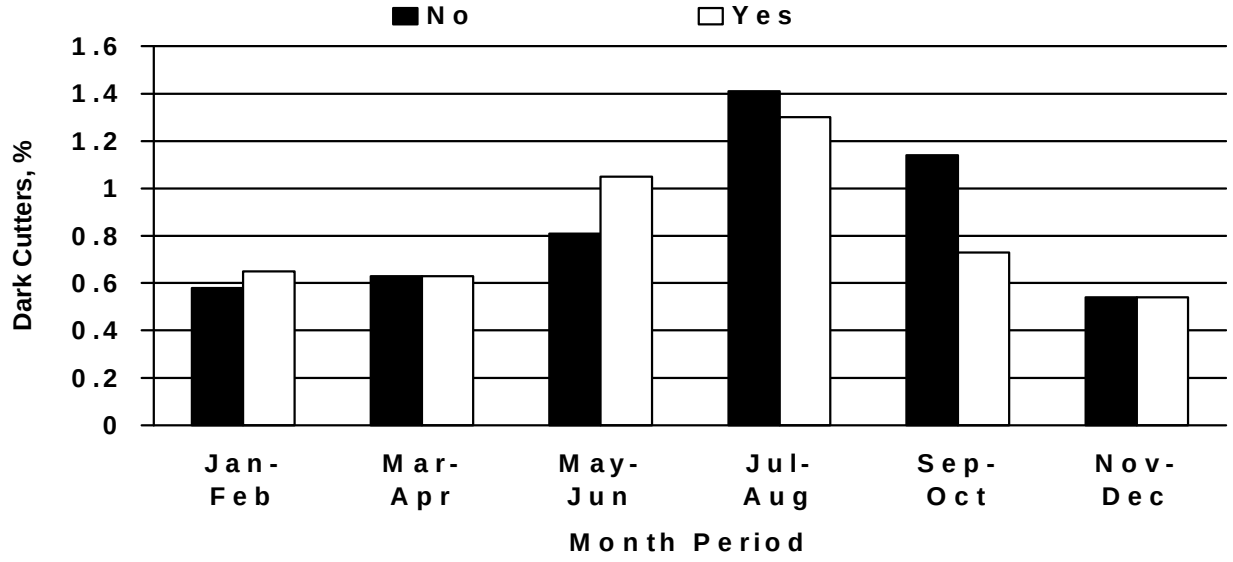


Fig. 4. Influence of precipitation on the day before slaughter on percentage of dark cutters.



stress and muscle glycogen levels as just discussed. It also may affect feed consumption patterns, thereby changing energy balance in the animal.

Our results indicate that weather conditions can influence the incidence of dark cutters. However, the role of weather is not well defined, because many other factors (management, environment, genetics) may have an overriding influence. Also, animal stress and muscle glycogen depletion prior to slaughter are accumulations of factors and events. Therefore, it has been extremely difficult for researchers to uncouple factors and provide definitive answers to what causes dark cutting beef. However, these data strongly suggest that weather conditions, especially temperature, may be one of many factors that potentiate muscle glycogen depletion and the incidence of dark cutting beef.

Southwest Research-Extension Center

COMPARISON OF LAIDLOMYCIN PROPIONATE AND MONENSIN AT EQUAL FEED INTAKES

by
Kelly K. Kreikemeier

SUMMARY

We conducted a finishing study to determine how well a new ionophore (Cattlyst) compares to Rumensin in a typical high grain diet. Feeding an ionophore had no effect on average daily gain, but feed intake was 3% less and efficiency improved 2% compared to feeding no ionophore. Over the entire 153-day study, no differences occurred between cattle fed Cattlyst (11.1g/ton) or Rumensin (27.8g/ton). Concentrations in bunk samples varied to a greater extent for Cattlyst than for Rumensin. The overall severity of liver abscesses was high across all treatments, and this might be expected because no antibiotic was fed. In this study, feeding an ionophore improved growth performance slightly, but no differences between Cattlyst and Rumensin were noted.

INTRODUCTION

Laidlomycin propionate is a new ionophore approved for use in beef cattle. It is to be included in the complete mixed ration at 5 to 10g/ton for improved feed efficiency in cattle fed in confinement for slaughter. Previous studies have demonstrated its effectiveness in improved growth performance of finishing cattle and its ability to reduce variation in feed intake in cattle adapting to a high grain diet. The objective of this study was to compare the effects of equal feed intakes of laidlomycin propionate and monensin on weight gain, feed efficiency, and carcass characteristics of steers.

PROCEDURES

Animal History. All cattle used in this study originated from sale barns in south central Missouri. Cattle were purchased as a mix of steers and bulls (50:50) and were mainly crossbreds of Angus, Hereford, and Charolais. Bulls were castrated within 50 days of arrival using an emasculator. No dairy, Corriente, or Brahman influence was apparent. Cattle arrived as three groups: one on 14 Dec 1994 (100 hd, av. wt. 454); another on 18 Feb 1995 (65 hd, av. wt. 488); and the third on 24 Feb 1995 (88 hd, av. wt. 520).

All cattle were injected with an 8-way clostridial vacinne, a 4-way modified live viral vaccine, and Ivermectin shortly after arrival. Forty four steers from group one that were not used in a wheat grazing study were implanted with Ralgro on about 15 March 1995, and cattle in groups two and three were implanted with Ralgro at processing (shortly after arrival).

The 12 heaviest steers in group one were used in a finishing study conducted from April to August, 1995. Fifty four steers from group one were used in a wheat grazing study from March through 15 June 1995. With the exception of wheat grazing, all other cattle were fed a corn silage:ground corn stover-based diet from arrival until 29 June, the start of this experiment. During that time, cattle gained about 1.5 lbs daily. From these three groups of cattle, the heaviest 180 were selected and used in this experiment. It began on 30 June and concluded on 30 Nov 1995 (153 days).

Animal Handling. Cattle were weighed in the morning before feeding, without pencil shrink. Initial and final weights were based on the averages of two consecutive daily weights. Interim single weights were taken every 28 d.

Cattle were stratified by weight and allotted to pens in the following manner. After being weighed on day one at the start of the experiment, cattle were ranked by weight, heaviest to lightest. Then cattle were separated into nine groups, with the heaviest 20 steers in group 1 and the lightest 20 steers in group 9. Then, within each group, cattle were allotted randomly

to 20 pens. In this manner, the ranges for starting weight were similar within each pen. There were four treatments and 20 pens, resulting in five pen replications per treatment with nine head per pen.

Initially, cattle were placed in pens with concrete flooring and fenceline concrete bulks. Pens were "pie shaped"; 18 ft wide at the front and 10 ft wide at the rear. They provided 24 inches of bunk length and 70 square ft of pen area per steer. At day 56, cattle were moved into open lot dirt pens that had fenceline concrete bunks with a concrete feeding apron. Pens were 60 ft long and 18 feet wide. This resulted in 24 inches of bunk length and 120 square feet of pen area per steer. Waterers were located within the fenceline at the back of the pen, such that one tank served two pens. Manure was removed from pens using a small skidloader as needed, which was about every 3 weeks.

Diet Formulation and Supplement Preparation. During diet formulation, the following ingredients were fixed, 5% alfalfa hay, 3% fancy bleachable tallow, and .7% urea. The balance of the diet contained steam-flaked corn (28 lb/bushel), soybean meal (44% CP), minerals, and vitamins (Table 1). The diet was formulated to contain 13.5% CP, .8% K, .6% Ca., .4% P, and .25% Mg. Diet formulation was based on previous feedstuff analysis here at SWREC (Table 2). Feedstuff analysis conducted at the end of the experiment showed that the actual nutrient composition was similar to the previous nutrient composition (Table 3). The diet also contained 1500 IU vit A, 300 IU vit D, and 20 IU vit E per lb of diet DM.

Cattle were adjusted to the final diet using three step-up diets. Step-up one contained 40% alfalfa hay and was fed from days 1 to 4. Step-up two contained 25% alfalfa hay and was fed from days 5 to 11. Step-up three contained 15% alfalfa hay and was fed from days 12 to 18. Cattle fed Cattlyst were fed their full dose of ionophore from day 1. Cattle fed Rumensin were adapted over a 6-d period. On days 1, 2, and 3, cattle were fed 1/3 Rumensin supplement and 2/3 control supplement. On days 4, 5, and 6, they received 2/3 Rumensin supplement and 1/3 control supplement. From day 7 till the end of the experiment (d 153), cattle were fed the full proportion of Rumensin supplement.

Dietary Treatments. Cattle had ad libitum access to a finishing diet containing either no ionophore, Cattlyst (11.1 g/ton DM), or Rumensin (27.8 g/ton DM). The fourth treatment included Cattlyst, but feed intake was restricted to the amount of feed consumed by cattle

Table 1. Ingredient composition of finishing diet (DM basis).[1]

Ingredient	Percent of diet
Steam flaked corn	81.9
Alfalfa hay	5.0
Beef tallow	3.0
SBM	6.77
Urea	.70
Limestone[2]	1.11
Monocalcium phosphate[2]	.38
Magnesium oxide	.24
Potassium chloride	.442
Salt	.30
Rumen 2x[3]	.0015
Vitamin E premix[4]	.0015
Zinc oxide	.0141
Trace mineral premix[5]	.025
Pellet binder[6]	.10

[1]Diet formulated to contain 13.5% CP, .8% K, .6% Ca, .3% P, and .25% Mg. Cattlyst added at 11.1 g/ton, and Rumensin at 27.8 g/ton (DM basis).
[2]Limestone and monocalcium phosphate were included as a mineral supplement. This "mineral" contained the appropriate ionophore.
[3]Contains 100,000,000 IU Vit A; 20,000,000 IU Vit D; and 100,000 IU Vit E/lb premix.
[4]Contains 125,000 IU Vit E/lb premix.
[5]Contains 14.9% zinc, 12.5% manganese, 12.5% iron, 6.7% sulfur, 3.7% copper, .19% iodine, and .05% cobalt.
[6]Included for those ingredients contained in the pellet. Those ingredients include SBM, urea, magnesium oxide, potassium chloride, salt, rumen 2X, vit E premix, zinc oxide, and trace mineral premix.

Table 2. Previous analysis of the feedstuffs fed in this study (DM basis).

	Nutrient				
Ingredient	CP	Ca	P	Mg	K
Corn	8.8	.02	.20	.10	.35
Alfalfa hay	18.0	1.25	.25	.25	2.5
SBM	51.0	.35	.70	.30	2.5

Table 3. Nutrient contents of the feedstuffs fed in this study (DM basis).

	Nutrient				
Ingredient	CP	Ca	P	Mg	K
Corn	8.8	.02	.25	.10	.35
Alfalfa hay	16.9	1.27	.21	.26	2.59
Pelleted supplement	62.2	1.17	.64	1.70	4.14
Mineral supplement	0	31.84	5.91	.41	.08

fed Rumensin (per head basis). This was accomplished in the following manner. The five pens of cattle fed Rumensin were "paired" with five pens of cattle fed Cattlyst. Within each "pair", the intake of the Rumensin pen set the amount of feed offered to the pen fed the Cattlyst diet restricted. This was done by calculating the 5-day rolling average of feed offered to each pen of cattle fed Rumensin. Then the 5-day rolling average was multiplied by the number of cattle in the pen fed Cattlyst and adjusted up or down to the nearest 5 lbs (scale increments on feed truck). Pens were paired in this manner so the cyclical changes that occur in feed intake would "tend" to be applied to each pen of cattle fed Cattlyst "restricted". If we had applied the "five pen average", we probably would have reduced fluctuation in feed intake, and that could have biased the results.

For cattle fed ad-libitum, the goal was to attain a slick bunk without cattle appearing hungry. A slick bunk occurred on an average of 2 out of 3 days.

Feed Mixing and Delivery to the Bunk. Cattle were fed once daily (9:00 AM) from a truck fitted with an Oswalt mixer box. It had about a 150-bushel capacity and three mixing augers. Feed was loaded in the following order: steam-flaked corn, chopped alfalfa hay, pelleted supplement, mineral supplement containing ionophore, and beef tallow. The mixer on the truck was started, and then the fat was poured onto the mixing feed.

Scales used to weigh out the feed ingredients included; 1) the feed truck for grain and hay, electronic, digital readout, 5-lb increments; 2) a certified hopper scale for pelleted supplement, mechanical arm beam balance, 5-lb increments; 3) an electronic platform for mineral supplement, digital readout, 0.2-lb increment readout; 4) a mechanical platform beam scale for beef tallow, 0.5 lb increment.

Feed was mixed and delivered to the feed bunk by the truck. Within each dietary treatment, the feeding order was rotated daily, so that the last pen fed was the first pen fed the following day.

Feed Sampling. Each dietary ingredient was sampled weekly and composited within month. Then, each monthly feed composite was analyzed at a commercial lab for CP, Ca, P, Mg, and K. For corn and alfalfa hay, nutrient content was similar to that from the previous feedstuff analysis (Tables 2 and 3). For the calculation of DM intake and feed/gain, DM was determined weekly on the complete mixed diet. We also collected bunk samples at 28-d intervals, and sent those to a laboratory to be assayed for ionophore concentrations. Values are expressed as a percent of target values of ionophore concentration.

Statistical Analysis. Data were analyzed as a completely random design using GLM procedures of SAS. For growth performance and carcass data, the pen mean was the statistical observation. If the main effect of treatment was significant ($P<.10$), treatment differences were separated using a t-test.

RESULTS AND DISCUSSION

Animal Performance. Initially, 45 head were allotted per treatment, nine head per pen and five pens per treatment. One steer died on 4 July of peritonitis, and another steer died on 8 Aug of water belly. Eleven other steers were removed from the experiment, seven on 4 July and four on 18 Aug. These cattle had developed soreness in their legs/joints. We consulted with the veterinarian, who diagnosed it as soreness/ injuries that probably developed because of the concrete flooring of the pens. As the experiment began, weather had remained wet for 2 weeks, keeping the pens slick. Previously, cattle were in dirt lots. As they adjusted to the concrete flooring, we assume that slipping occurred and may have resulted in the injuries. We have not experienced this problem previously or after this study.

For cattle removed from the experiment, feed consumed up to the time of animal removal was subtracted from feed offered. It was weighted on a per-animal, per-day basis and applied to appropriate pens accordingly.

Starting weight was 708 lbs and final weight was 1245 lbs (Table 4). Cattle fed the Cattlyst ad-lib were the heaviest at the end of the experiment, but the difference was not significant ($P = .54$).

Significant differences in daily gain occurred during period 5 (d 112 to d 140), when cattle fed Rumensin gained faster than cattle in the other

three treatments (P < .10). For the overall experiment, daily gain varied from 3.38 to 3.52 lbs per day.

For feed intake, significant treatment effects occurred during period 4 (d 84 to d 112) and period 6 (d 140 to d 153). During period 4, feed intake was highest for cattle fed Cattlyst ad-lib and lowest for cattle fed Cattlyst restricted (P < .10). During period 6, feed intake was greatest for cattle fed no ionophore and lowest for cattle fed Cattlyst restricted (P < .10). For the overall experiment, no significant differences occurred (P=.18).

During period 5 (d 112 to d 140), cattle fed Rumensin were more efficient than cattle fed the other three treatments (P < .10). For the overall experiment, feed efficiency ranged from 5.32 to 5.54 and was unaffected by treatment (P=.14).

No significant differences occurred in carcass traits. However, it is important to note that whether cattle were fed either Rumensin ad-lib or Cattlyst restricted, carcass weights were the same. For final live weights, cattle fed Rumensin were 19 lbs heavier. A high incidence and severity of abscessed livers occurred across treatments. This might be expected because no antibiotic was fed.

Ionophore concentration in bunk samples varied. Concentration of Rumensin was greater than concentration of Cattlyst at the ends of periods 1 and 2 (P < .01) whereas concentrations were close to target values for all treatments at the end of periods 3 and 5. During period 4, concentration of Rumensin was close to target (94%), whereas concentration of Cattlyst was 250% of the target value. Even the concentration of Cattlyst in control samples was 19% of the target value for Cattlyst treatments.

The low Cattlyst concentration at day 56 can be explained by the low concentration in the supplement (only 56% of target). At day 112, Cattlyst concentration in the supplement was 98% of the target value but 250% of target in bunk samples. Why concentration in bunk samples was so high cannot be explained.

Table 4. Effects of ionophore feeding on animal growth performance, carcass traits, and ionophore concentration in bunk samples.

Item	Rumensin	Cattlyst Ad-lib	Cattlyst Restricted	Control	SE	P-value
# Steers	44	42	39	41		
Initial weight, lb	705	707	708	711	1.5	
Final weight, lb	1245	1256	1226	1252	15.4	.54
Daily gain, lb/day						
Period 1	3.47	4.17	3.57	3.93	.32	.41
Period 2	3.84	3.80	3.23	3.72	.24	.29
Period 3	3.85	3.61	4.03	3.47	.21	.29
Period 4	3.83	4.13	3.75	4.01	.19	.53
Period 5	3.08[a]	2.57[b]	2.66[b]	2.64[b]	.12	.03
Period 6	2.59	2.81	2.71	3.01	.44	.92
Total	3.52	3.58	3.38	3.52	.09	.49
Daily feed intake, lb						
Period 1	19.09	20.11	19.35	21.12	.68	.62
Period 2	18.61	19.69	18.72	20.21	.62	.24
Period 3	18.55	19.04	18.37	18.82	.36	.58
Period 4	20.11[a]	21.24[b]	19.70[a]	20.61[ab]	.41	.09
Period 5	19.35	18.91	18.62	19.91	.39	.15
Period 6	18.92[ab]	19.58[ac]	18.45[b]	20.14[c]	.33	.01
Total	18.73	19.58	18.59	19.47	.37	.18
Feed/gain						
Period 1	5.91	4.89	5.66	5.14	.57	.57
Period 2	4.97	5.23	5.82	5.47	.32	.33
Period 3	4.82	5.35	4.61	5.55	.32	.18
Period 4	5.28	5.17	5.32	5.15	.23	.94
Period 5	6.30[a]	7.46[b]	7.01[b]	7.58[b]	.29	.03
Period 6	8.10	7.21	21.32	6.86	7.93	.52
Total	5.32	5.47	5.51	5.54	.13	.14
Carcass traits[1]						
Hot carcass wt, lbs	778	792	779	788	9	.63
Backfat, in	.49	.48	.49	.53	.03	.63
Quality grade	2.72	3.15	2.83	3.03	.21	.45
KPH, %	3.00	2.90	2.89	2.98	.07	.65
Rib eye area	13.97	14.22	14.10	13.87	.18	.57
Liver score	.95	.83	.96	.67	.21	.75
Yield grade	2.82	2.73	2.73	2.98	.09	.32
Ionophore concentration in bunk samples[2]						
Day 28	132.6[a]	79.8[b]	84.8[b]	0.0[c]	3.3	.01
Day 56	84.4[a]	63.8[b]	64.2[b]	5.0[c]	5.3	.01
Day 84	102.0[a]	107.8[a]	112.6[a]	5.2[b]	4.6	.01
Day 112	94.4[a]	251.6[b]	269.8[b]	19.6[a]	38.0	.01
Day 140	110.6[a]	98.0[b]	102.4[ab]	4.4[c]	4.0	.01

[1] Quality grade: 0 = practically devoid, 1 = traces, 2 = slight, 3 = small.
Liver score: 0 = no abscess, 1 = 1 or 2 small abscesses, 2 = 1 or 2 medium abscesses, 3 = several abscesses or adhered to the body wall.

[2] Expressed as a percent of target values.

[a,b,c] Means in the same row with different superscripts are different (P<.10).

Southwest Research-Extension Center

EFFICACY OF LAIDLOMYCIN PROPIONATE, MONENSIN, OR LASALOCID FOLLOWED BY LAIDLOMYCIN PROPIONATE FOR IMPROVING WEIGHT GAIN AND FEED EFFICIENCY IN STEERS.

by
Kelly K. Kreikemeier

SUMMARY

We conducted an experiment to compare effects of feeding either Cattlyst or Bovatec followed by Cattlyst to feeding Rumensin on growth performance of finishing steers. Feeding an ionophore had no effect on daily gain but reduced feed intake and improved feed efficiency by 2.5% compared to feeding no ionophore. Over the entire experiment, cattle fed Rumensin consumed less feed than cattle fed either Bovatec followed by Cattlyst or no iononphore. Cattle fed Rumensin or Bovatec followed by Cattlyst tended to be more efficient (P=.15) than cattle fed either Cattlyst or no ionophore, however, cattle that were more efficient also tended to have leaner carcasses. Ionophore concentration in bunk samples varied. It was 84% of the target value for Cattlyst or Bovatec followed by Cattlyst compared to 112% of the target value for Rumensin.

INTRODUCTION

Laidlomycin propionate is a new ionophore approved for use in beef cattle. It is to be included in the complete mixed ration at 5 to 10g/ton for improved feed efficiency in cattle fed in confinement for slaughter. Previous studies have demonstrated its effectiveness in improved growth performance of finishing cattle and its ability to reduce variation in feed intake in cattle adapting to a high grain diet. The objective of this study was to determine the effects of laidlomycin propionate (Cattlyst), monensin (Rumensin), or lasalocid (Bovatec) followed by laidlomycin propionate on feed intake, weight gain, feed efficiency, and carcass characteristics in finishing steers.

PROCEDURES

Animal History. All cattle used in this study originated from sale barns in south central Missouri. Cattle were purchased as a mix of steers and bulls (50:50) and were mainly crossbreds of Angus, Hereford, and Charolais. Bulls were castrated within 50 days of arrival using an emasculator. No influence of dairy, Corriente or Brahman was apparent. Cattle arrived as three groups; one on 7 Oct 1994 (117 hd., av. wt. 566 lbs); another on 27 Oct and 7 Nov 1994 (160 hd., av. wt. 608 lbs); and the third group on 14 Dec 1994 (100 hd., av. wt. 454 lbs).

All cattle were injected with an 8-way clostridial vaccine, a 4-way modified live viral vaccine, and Ivermectin shortly after arrival. Cattle in groups one and two were implanted with Ralgro on about 1 Dec 1994, and cattle in group three were not implanted until the start of this experiment. At the time cattle from groups one and two were implanted, the heaviest 128 head were sorted and used in a finishing study that began on 3 Feb 1995. The next heaviest group of 100 head was used in a growing study that lasted 105 days. The diet consisted of 53% corn stalks and 47% concentrate (wheat midds, sunflower meal, and mineral). During the growing study, cattle gained 1.26 lbs per day. With the exception of the previously described protocol, all cattle were fed an 80% corn-silage diet from arrival till the start of this experiment and had gained weight at a rate of about 1.75 lbs per head per day.

In this experiment, the 100 steers fed corn stalks and the next heaviest 60 steers remaining from groups one, two, and three were used. These steers were implanted with Synovex-S at the start and Revalor-S at day 56. The experiment started on 2 April and ended on 21 August, 1995 (140 d).

Animal Handling. Cattle were weighed in the morning before feeding, without pencil shrink. Initial and final weights were based on the averages of two consecutive daily weights. Interim single weights were taken every 28 d. All weights were taken in the morning, before feeding.

Cattle were stratified by weight and allotted to pens in the following manner. After weighing the cattle on day one at the start of the experiment, cattle were ranked by weight, heaviest to lightest. Then cattle were separated into nine groups so that the heaviest 20 steers were in group 1 and the lightest 20 steers in group 8. Then, within each group, cattle were allotted randomly to 20 pens. In this manner, the range for starting weights was similar within each pen. There were four treatments and 20 pens, resulting in five pen replications per treatment with eight head per pen.

Cattle were placed in open-lot dirt pens that had fenceline concrete bunks with a concrete feeding apron. Pens were 60 feet long and 18 feet wide. This resulted in 27 inches of bunk length and 135 square feet of pen area per steer. Waterers were located within the fenceline at the back of the pen, such that one tank served two pens. Manure was removed from pens using a small skidloader as needed, which was about every 3 weeks.

Diet Formulation and Supplement Preparation. During diet formulation, the following ingredients were fixed, 5% alfalfa hay, 3% fancy bleachable tallow, and .7% urea. The balance of the diet contained steam-flaked corn (28 lb/bushel), soybean meal (44% CP), minerals, and vitamins (Table 1). The diet was formulated to contain 13.5% CP, .8% K, .6% Ca., .4% P, and .25% Mg. Diet formulation was based on previous feedstuff analysis here at SWREC (Table 2). The diet also contained 1500 IU vit A, 300 IU vit D, and 20 IU vit E per lb of diet DM.

Cattle were adjusted to the final diet using three step-up diets. Step-up one contained 40% alfalfa hay and was fed from days 1 to 4. Step-up two contained 25% alfalfa hay and was fed from days 5 to 11. Step-up three contained 15% alfalfa hay and was fed from days 12 to 18. Cattle fed Bovatec or Catalyst were fed their full dose of ionophore from day 1. Cattle fed Rumensin were adapted over a 6-d period. On days 1, 2, and 3, cattle on the Rumensin treatment were fed 1/3 Rumensin supplement and 2/3 control supplement. On days 4, 5, and 6, they received 2/3 Rumensin supplement and 1/3 control supplement. From day 7 till the end of the experiment, cattle were fed the full proportion of Rumensin supplement.

Feed Mixing and Delivery to the Bunk. Cattle were fed once daily in the morning from a truck fitted with an Oswalt mixer box. It had about 150 bushel capacity and three mixing augers. Feed was loaded in the following order; steam-flaked corn, chopped alfalfa hay, pelleted supplement, mineral supplement, and beef tallow. The mixer on the truck was started, and then the fat was poured onto the mixing feed.

Feed was mixed and delivered to the feed bunk by the truck. Within each dietary treatment, the feeding order was rotated daily, so that the last pen fed was the first pen fed the following day.

Table 1. Ingredient composition of finishing diet fed in Cattlyst experiment (DM basis).[1]

Ingredient	Percent of diet
Steam-flaked corn	81.9
Alfalfa hay	5.0
Beef tallow	3.0
SBM	6.77
Urea	.70
Limestone	1.11
Monocalcium phosphate	.38
Magnesium oxide	.24
Potassium chloride	.442
Salt	.30
Rumen 2x	.0015
Vitamin E premix	.0015
Zinc oxide	.0141
Trace mineral premix	.025
Pellet binder	.10

[1] Diet formulated to contain 13.5% CP, .8%K, .6% Ca, .3% P, and .25% Mg. Cattlyst added at 11.1 g/ton, Rumensin at 27.8 g/ton, and Bovatec at 33.3 g/ton, DM basis.

Table 2. Previous analysis of the feedstuffs fed in this study.

	Nutrient				
Ingredient	CP	Ca	P	Mg	K
Corn	8.8	.02	.20	.10	.35
Alfalfa hay	18.0	1.25	.25	.25	2.5
SBM	51.0	.35	.70	.30	2.5

Table 3. Nutrient content of feedstuffs fed during the study.

	Nutrient				
Ingredient	CP	Ca	P	Mg	K
Corn	8.8	.02	.25	.10	.35
Alfalfa hay	16.9	1.27	.21	.26	2.59
Pelleted supplement	62.2	1.17	.64	1.70	4.14
Mineral supplement	0	31.84	5.91	.41	.08

Scales used to weigh out the feed ingredients included; 1) the feed truck for grain and hay, electronic, digital readout, 5-lb increments; 2) a certified hopper scale for pelleted supplement, mechanical arm beam balance, 5-lb increments; 3) an electronic platform for mineral supplement, digital readout, 0.1-lb increment; 4) a mechanical platform beam scale for beef tallow, 0.5 lb increment.

Feed Sampling. Each dietary ingredient was sampled weekly and composited within month. Then, each monthly feed composite was analyzed at a commercial lab for DM, Ca, P, Mg, and K. For the calculation of DM intake and feed/gain, DM was conducted weekly on the complete mixed diet. The diet was sampled at feeding time. Bunk samples also were collected every 28 d and sent to a laboratory for assay of ionophore concentration.

Statistical Analysis. Data were analyzed as a completely random design using GLM procedures of SAS. For growth performance data by period (period 1 to 5; 28 day periods), overall growth performance data (d 140), and carcass data, the pen mean was the statistical observation. If the main treatment effect was significant (P<.10), the treatment differences were separated using a t-test.

RESULTS AND DISCUSSION

Diet Formulation and Nutrient Specifications. Diets were formulated based on previous feed analysis conducted here at SWREC (Table 2). Based on nutrient analysis conducted at the end of the study (Table 3) of the feed ingredients used in the experiment, targeted nutrient specifications were achieved.

Manufacturing Supplements. Initially, the supplement was pelleted and formulated to contain all ingredients except tallow, steam-flaked corn, and alfalfa hay. With this protocol, ionophore recovery in the pellet was 85% of the target value for Bovatec and 80% for Cattlyst. This pelleted supplement was fed from days 1-17. The supplement then was manufactured as a pellet plus mineral premix. The mineral premix contained limestone, monocalcium phosphate, mineral oil, and the ionophore. The new pellet contained the original ingredients minus those in the mineral premix. The mineral premix and ionophore were combined because of the simplicity of the closed mixing system used. It was a 2-ton mixer with a vertical mixing auger. The mixer could be emptied and the mineral bagged with virtually complete cleanup (no carryover) at each step in the process. Recovery in the mineral supplement was 100% for Bovatec and varied from 79% to 103% for Cattlyst. For Rumensin, the recovery was variable: 43 to 55% from one lab, and 89.1% from another lab.

Animal Performance. Initially, 40 head were allotted per treatment, eight per pen and five pens per treatment. One steer fed the control supplement died of bloat on 11 June 1995. This steer had shown signs of bloat on 8 and 9 June as well. Feed intake for this steer was mathematically deleted from its pen by subtracting 12.5% of the feed offered from 2 April through 10 June. Ten observations of bloat were made during this experiment. They occurred in cattle fed the control supplement and in cattle fed Bovatec for the initial 28 d and then switched to Cattlyst. The bloating occurred between 8 June and 20 August.

Initial weight was 723 lbs, and final weight was 1300 lbs (Table 4). Cattle fed the Cattlyst supplement were the lightest at the end of the experiment, whereas cattle fed Bovatec followed by Cattlyst were the heaviest.

Cattle gained weight very rapidly during the first 28 d (5.73) and also were extremely efficient (3.61 feed/gain). This probably was due to changes in gut fill and compensatory gain. Before the experiment began, 100 of the 160 steers had been fed a corn stalk:wheat midd diet for 105 d and gained 1.26 lb/d. Therefore, a portion of the exceptional growth that occurred during the initial 28 d could be attributed to compensatory growth.

Daily gain declined over each consecutive 28-d period. During period 4 (d 84 to 112), cattle fed the control supplement gained slower (P<.10) than cattle fed supplements containing ionophores. Over the entire experiment, daily gain ranged from 4.05 to 4.23 lb/d and was not affected by treatment (P>.10).

During the first 56 days, cattle fed either the Cattlyst supplement or the control supplement consumed 3.5 to 8.6% more feed (P<.10) than cattle fed the Rumensin supplement. From d 56 to 140, no differences occurred in feed intake. Tallied over the entire experiment, cattle fed the control supplement or Bovatec followed by Cattlyst consumed more feed (P<.10) than cattle fed the Rumensin supplement.

Over the entire experiment, no significant differences occurred in feed efficiency (P = .15). Significant differences in feed efficiency occurred during period 4 (d 84 to 112), when cattle fed the control supplement were less efficient than cattle fed ionophores. The greatest frequncy of bloating occurred

Table 4. Effects of ionophore feeding on animal growth performance, implant score, carcass traits, and ionophore activity in bunk samples.

Item	Ionophore				SE	P-value
	Cattlyst	Control	Bovatec and Cattlyst	Rumensin		
# Steers	40	39	40	40		
Initial weight, lb	721	723	724	723	2.5	
Final weight, lb	1288[a]	1299[ab]	1315[b]	1299[ab]	7.3	.10
Daily gain, lb/d						
Period 1	5.86	5.76	5.73	5.58	.14	.56
Period 2	4.49	4.31	4.39	4.31	.21	.91
Period 3	3.69	4.37	4.14	4.10	.22	.21
Period 4	3.36[a]	2.82[b]	3.80[a]	3.35[a]	.17	.01
Period 5	2.78	3.33	3.01	3.18	.19	.27
Total	4.05	4.13	4.23	4.11	.06	.25
Daily feed intake, lb						
Period 1	20.73[a]	21.04[a]	20.96[a]	20.00[b]	.25	.03
Period 2	22.53[a]	22.93[a]	21.81[b]	21.11[b]	.34	.01
Period 3	20.72	21.24	21.51	21.28	.40	.56
Period 4	21.20	21.71	21.66	21.15	.50	.79
Period 5	20.89	21.22	21.04	20.09	.55	.49
Total	21.38[ab]	21.80[a]	21.55[a]	20.88[b]	.45	.07
Feed/gain						
Period 1	3.54	3.66	3.67	3.58	.09	.75
Period 2	5.03	5.33	5.04	4.96	.22	.66
Period 3	5.71	4.90	5.27	5.22	.31	.35
Period 4	6.33[a]	8.05[b]	5.71[a]	6.31[a]	.47	.01
Period 5	7.63	6.50	7.06	6.32	.38	.11
Total	5.28	5.29	5.10	5.08	.07	.15
Carcass traits[1]						
Hot carcass wt, lb	802	809	810	807	10	.93
Backfat, in	.47[a]	.46[ab]	.47[ab]	.41[b]	.01	.07
Quality grade	3.57	2.99	3.15	3.10	.26	.44
KPH, %	2.43[a]	2.39[ab]	2.11[c]	2.19[bc]	.07	.01
Rib eye area	14.46	14.01	14.49	14.73	.22	.18
Liver score	.87	.68	.90	.52	.20	.53
Yield grade	2.65[a]	2.79[a]	2.61[ab]	2.38[b]	.08	.02
Ionophore concentration in bunk samples[2]						
Day 28	110.8[a]	8.0[b]	104.6[a]	109.4[a]	6.3	.01
Day 56	54.0[a]	3.8[b]	46.6[a]	104.4[c]	4.3	.01
Day 84	119.8[a]	8.0[b]	120.2[a]	143.4[c]	6.2	.01
Day 112	84.2[a]	0[b]	92.8[a]	113.8[c]	5.2	.01
Day 140	52.6[a]	0[b]	57.0[a]	87.4[c]	2.7	.01
Average	84.2[a]	4.0[b]	84.2[a]	111.7[c]	2.5	.01

[1] Quality grade: 0 = practically devoid, 1 = trace, 2 = slight, 3 = small.
Liver score: 0 = no abscess, 1 = 1 or 2 small abscesses, 2 = 1 or 2 medium abscesses, 3 = several abscesses or adhered to the body wall.

[2] Expressed as a percent of target values.

[a,b,c] Means in the same row with different superscripts are different (P<.10).

during period 3, so the poor feed efficiency during period 4 for control cattle likely was not due to bloat.

No statistical differences occurred in hot carcass weight across treatments, whereas differences did occur in final body weight. Cattle fed the Cattlyst supplement had more backfat (P<.10), more KPH (P<.10), and a higher yield grade (P<.10) than cattle fed the Rumensin supplement. This is important to note, because cattle fed Cattlyst or the control supplement were the least efficient but also had the fattest carcasses.

Ionophore Concentration in the Bunk Samples. Ionophore concentration in bunk samples varied from 54 to 120% of the target value for cattle fed the Cattlyst supplement and from 87 to 143% for cattle fed the Rumensin supplement. Averaged across the entire experiment, bunk samples containing Cattlyst or Bovatec followed by Cattlyst had lower values than bunk samples containing Rumensin (P<.10, 84 vs 112%). Why Cattlyst concentration was only half of the target value at d 56 and again at d 140 is difficult to explain because the supplement inventory was normal, and when supplements were manufactured, they contained very close to target values. Another interesting observation is that the analysis conducted showed variable recovery of Rumensin in the mineral supplement vs excellent recovery in the bunk samples.

Southwest Research-Extension Center

FEEDLOT PERFORMANCE AND CARCASS CHARACTERISTICS OF HEIFERS IMPLANTED WITH COMPONENT E-H AND COMPONENT T-H OR FINAPLIX-H

by
Kelly Kreikemeier and John Unruh

SUMMARY

Two hundred heifers (614 lb) were used in a randomized incomplete block design to determine if implanting with Component T-H plus Component E-H had different effects than implanting with Finaplix - H plus Component E-H. Treatments included: 1) no implant, 2) implanting with Component E-H in the right ear plus Component T-H in the left ear, and 3) implanting with Component E-H in the right ear plus Finaplix-H in the left ear. The dosages of treatments 2 and 3 were identical: 20 mg of estradiol benzoate, 200 mg testosterone propionate, and 200 mg trenbolone acetate. Heifers were fed 139 days and then slaughtered. Implanted heifers tended to consume more feed (3.3%; $P > .10$), gained 13.4% faster ($P < .10$), and were 8.8% more efficient ($P < .10$) than nonimplanted cattle. Dressing percent was similar across treatments, and implanted cattle had heavier carcasses (24 lb; $P < .10$) than nonimplanted heifers. We observed a numerical tendency for nonimplanted heifers to have higher marbling scores and more carcasses that graded choice than implanted heifers. Implanted cattle had higher lean maturity scores ($P < .10$), but bone maturity was similar across implant treatments. Implanted cattle had bigger ribeyes ($P < .10$), but this was due to bigger carcasses; that is, per unit of carcass weight, ribeye area was identical across treatments. Implanted cattle showed a tendency for more dark cutting carcasses, but this likely occurred because the cattle were comingled, loaded, and shipped 13 hours before slaughter. We conclude that implanting heifers with this implant combination improves feedlot growth performance and that source of trenbolone acetate (Component T-H or Finaplix-H) makes no difference.

INTRODUCTION

Trenbolone acetate has been approved for use as an implant to improve feedlot growth performance for several years. Recently, a new implant containing trenbolone acetate has been approved for use in feedlot heifers (Component T-H). The objective of this study was to determine if feedlot performance and carcass traits were similar between heifers implanted with either Component T-H or Finaplix-H.

PROCEDURES

Animal Selection. On 9 Nov 1996, we received 100 heifers from Vienna, MO; on 10 Nov 1996, we received 107 heifers from Bloomfield, IA; and on 11 Dec 1996, we received 248 heifers from La Junta, CO. Cattle were processed within 24 h of arrival. Processing included: 1) an eartag in each ear, 2) injectable Ivomec for internal and external parasites, 3) BRSV Vac 9, a modified live viral injection, 4) Vision-8, a killed clostridial, and 5) dehorning. Between 17 Nov 1996 and 5 Jan 1997, five heifers died.

The 450 heifers remaining were weighed and checked for pregnancy by rectal palpation on 6 and 7 Jan 1997. Seven heifers were diagnosed pregnant and removed from the group. Twenty three other heifers also were removed for various reasons. We palpated each ear to verify that no implants were present.

The 420 heifers remaining were ranked from heavy to light. On 9 and 10 Jan 1997, we removed the heaviest 7 heifers and the lightest 168. This gave us a more uniform group (based on weight). Using the weights from day-1 (13 Jan 1997), these 245 animals were ranked from heavy to light. Then we calculated a standard deviation, a mean, and a coefficient of

variation for a consecutive group of 200 animals. This was conducted for 45 possible combinations; animal 1 to 200, animal 2 to 201, animal 3 to 202, animal 4 to 203, animal 5 to 204, etc. The lowest coefficient of variation occurred for the combination beginning with animal 36 and ending animal 235. This group of 200 was used in the experiment. Weight ranged from 656 to 564 lb, with an average of 608 lb; the standard deviation was 24.47 lb; and the coefficient of variation was 4.025%. The study began on 14 Jan 1997 (day 0) and concluded on 2 June 1997 (d 139).

Experimental Design and Treatment Description. The experiment was a randomized incomplete block design including four weight blocks with three treatments (pens) per block and four weight blocks with two treatments per block. Treatments were: 1) no implant, 2) implanting Component E-H in the right ear and Finaplix-H in the left ear, and 3) implanting Component E-H in the right ear and Component T-H in the left ear. The dosages for treatments 2 and 3 were identical: 20 mg estradiol benzoate, 200 mg testosterone propionate, and 200 mg of trenbolone acetate. We had four pen replications for nonimplanted cattle and eight pen replications for each implant treatment. Implants were administered once at the start of the experiment.

Experimental Animal Facilities and Handling. The experimental pens used were open lot, dirt pens with concrete fenceline bunks and automatic waterers. The pens had a 10-ft-wide concrete feeding apron, and waterers were located in the back of the pen (opposite the bunks) such that two pens shared the same waterer. The pens measured 18 ft by 60 ft, resulting in 108 sq ft of pen area and 18 inches of linear bunk space per animal. Before the experiment started, manure was removed from the pens, and dirt was hauled in to "reshape" the pens. After the experiment started, manure was removed from the pens as needed using a small skidloader (about every 3 weeks).

Experimental Diets and Feeding. Before the experiment began, we sampled the primary feedstuffs that would make up the finishing ration and sent them to a commercial laboratory for analysis (Table 1). During diet formulation (Table 2), the following ingredients were fixed (dry matter basis): 10% corn silage, 6% soybean meal, 3% fancy bleachable tallow, and the grain portion of the ration containing 70% high moisture milo and 30% steam-flaked corn. Then the ration was balanced to contain 13.5% CP using urea, .7% K, .6% Ca, .4% P, and .2% Mg. Rumensin and Tylan were

Table 1. Nutrient analysis of feedstuffs (DM basis) used to formulate the finishing ration.

Feedstuff	CP	K	Ca	P	Mg
Soybean meal	51.6	2.52	.34	.68	.31
Corn silage	8.0	1.25	.26	.17	.19
Steam-flaked corn	7.8	.34	.01	.26	.10
High-moisture milo	10.6	.48	.03	.34	.14

Table 2. Ingredient composition of the finishing diet[1].

Ingredient	Percent of diet DM
High-moisture milo	54.6
Steam-flaked corn	23.4
Corn silage	10
Soybean meal	6
Beef tallow	3
Urea	.694
Limestone	1.14
Dicalcium phosphate	.493
Potassium chloride	.163
Magnesium oxide	.111
Salt	.30
Rumensin 80 premix[2]	.019
Tylan 40 premix[2]	.012
Vitamin A premix[3]	.0007
Vitamin D premix[3]	.0015
Vitamin E premix[3]	.016
Beef trace mineral premix[4]	.015
Mineral oil[5]	.03

[1] The ration was balanced to contain 13.5% CP, .7% K, .6% Ca, .4% P, and .2% Mg. With the exception of the grain, silage, SBM, and beef tallow, all other ingredients were fed as a mineral supplement.

[2]Rumensin and Tylan were added to the supplement so that each ton of complete diet would contain 30 g monensin and 10 g tylosin.

[3]Vitamin premixes were added to the supplement so each pound of complete diet would contain 2000 IU vit A, 200 IU vit D, and 20 IU vit E.

[4]Beef trace mineral premix contained (g/kg premix) 55 Ca, 5 Co, 24 Cu, 1.6 I, 40 Fe, 160 Mn, .8 Se, and 240 Zn.

[5]Included in the mineral supplement as a binder.

added to the supplement so that the diet would contain 30 g monensin and 10 g tylosin per ton. Vitamin premixes were added to the supplement so that the diet would contain 2000 IU vit A, 200 IU vit D, and 20 IU vit E per lb.

Cattle were stepped up to their final diet in 14 days using two step-up diets fed for 7 days each. Step-up one contained 40% corn silage, and step-up two contained 25% corn silage (DM basis). Silage was substituted for the grain portion of the final diet.

Dry matter (DM) was determined weekly for individual dietary ingredients and the total mixed ration. Ingredient DM was used to make changes in the amount of each ingredient to load in a batch of feed, and DM of the total mixed ration was used to calculate feed intake and feed to gain ratio. After DM was determined on the total mixed ration, it was composited within month and analyzed at a commercial laboratory at the end of the study.

Feed refusals were scooped from the bunk of each pen at 7:00 AM on days 28, 56, 84, 112, and 139. Feed was weighed, subsampled, and discarded. Subsamples were placed in a forced air oven and dried for DM determination.

Cattle were fed once daily at about 9:00 AM. The cattle were offered feed with the goal that at feeding time the bunk would be "slick" but cattle would approach the bunk in a nonaggressive manner. A slick bunk occurred on about 2 out of every 3 days. Also, per load of feed, the feeding order was rotated daily, such that the last pen fed on a given day would be the first pen fed the next day.

Experimental Activities and Observations. Animals were weighed on 2 consecutive days at the start of the experiment and once on days 28, 56, 84, 112, and 139. Animals were weighed between 8:00 and 10:00 AM. Weights were recorded and reported as "full weights", however, cattle were always fed after weighing. On day 28, when cattle were weighed, we palpated the implant sites to verify that implants were present and/or if abscesses had formed.

Cattle were loaded on five semi trailers on 2 June 1997, between 6:00 and 7:30 PM and hauled 10 miles to a commercial slaughter facility in Garden City. On the morning of 3 June 1997, cattle were slaughtered beginning at 7:50 AM. We recorded kill order, identified each carcass with a sequence number, and recorded the incidence and severity of liver abscesses. After carcasses had chilled for 24 h, we obtained carcass data. including ribeye area; 12th rib backfat; kidney, pelvic, and heart fat; marbling score; lean maturity; bone maturity; and the incidence and severity of dark cutters.

Statistical Analysis. Means were generated on a pen basis for growth performance and carcass traits. Data were analyzed as a randomized incomplete block design. If the effect of implant was significant ($P < .10$), means were separated using a t-test ($P < .10$).

RESULTS AND DISCUSSION

Nutrient Analysis of Diets Fed. Crude protein contents of step-up one and two were less than target values (Table 3). This is because of the protein and energy dilution that occurred when corn silage was substituted for grain. Because no attempts were made to feed additional protein with the step-up diets, dietary crude protein was less than that targeted for the finishing diet. Analysis of crude protein and the macro-minerals in the finishing diet ranged from target values to slightly above target values. We did not analyze individual ingredients during the experiment, but nutrient analysis of individual ingredients fed during the experiment apparently varied compared to those ingredients sampled and analyzed before the experiment began.

Table 3. Nutrient analyses of step-up one, step-up two and monthly composites of the final diet (percent of diet DM).

Diet	CP	K	Ca	P	Mg
Step-up one	12.8	.9	.4	.35	.17
Step-up two	13.1	.83	.61	.38	.18
Final diet, January	14.1	.75	.54	.44	.16
Final diet, February	14.2	.71	.81	.46	.17
Final diet, March	15.5	.8	.86	.5	.23
Final diet, April	14.3	.7	.69	.44	.28
Final diet, May	14.6	.71	.69	.45	.22
Target analysis	13.5	.7	.6	.4	.2

Animals Removed from the Study. Two cattle were removed from the study at day 28 because an implant was missing. Eight other cattle had small abscesses, or the pellets were "bunched" or "gapped", but these cattle remained in the study. On 18 May 1997, a heifer was hung up in a gate and choked. Feed intake for these three pens was corrected by subtracting 10% from the feed offered for the days when the animal was present in the pen.

Growth Performance and Carcass Traits. Initially, cattle weighed 614 lb, and final weight was heavier in implanted cattle ($P < .10$; Table 4). Feed intake was 16 lb per head per day during period 1 and increased slightly with each 28-day period. Overall (139 d), feed intake varied from 17.5 to 18.4 lb per head per day, and feed intake tended to be greater (3.4%; $P > .10$) in implanted cattle compared to nonimplanted cattle.

During periods 1, 2, and 3, implanted cattle consistently gained faster than nonimplanted cattle ($P < .10$), whereas during period 4, the opposite tended to occur ($P > .10$). During period 5, implanted cattle again gained faster than nonimplanted cattle ($P < .10$). Overall, implanted cattle gained 13.4% faster than nonimplanted cattle ($P < .10$), and daily gain in the two implanted groups was identical.

Feed efficiency was improved in implanted cattle compared to nonimplanted cattle during periods 1, 3, and 5 ($P < .10$). Overall, feed efficiency was improved 8.8% in implanted cattle ($P < .10$).

Dressing percent was similar across all three implant treatment groups. Similar to final live weight, implanted cattle had heavier carcasses compared to nonimplanted cattle ($P < .10$). We observed a numerical tendency for nonimplanted cattle to have a higher marbling score and more carcasses that graded Choice compared to implanted cattle. Overall, the 20% Choice carcasses in this study was less than the typical percentage for young "calf feds" slaughtered in June in the High Plains area.

Carcass lean maturity was greater ($P < .10$) in implanted cattle compared to nonimplanted cattle. However, bone maturity was similar across implant treatments. A numerical tendency occurred for a higher dark cutter score and a greater number of dark cutting carcasses in implanted cattle compared to nonimplanted cattle. More dark cutters in implanted cattle must be interpreted cautiously, because this was not statistically significant. However, implanting heifers with this implant combination may increase the incidence of dark cutters, if cattle are comingled and loaded several hours before slaughter.

A numerical tendency occurred for a higher incidence of liver abscesses in implanted cattle. The overall abscess rate of 8.1% in implanted cattle is similar to results of other experiments conducted at SWREC. Ribeye area was bigger ($P < .10$) in implanted cattle, but this was due to bigger carcasses. When expressed per 100 lb of carcass weight, ribeye area was identical across all three implant groups. Percent KPH fat was similar across treatments, as was the calculated yield grade. The low yield grade (average 1.5) was primarily due to the small amount of backfat and the greater than average loineye area. This might be expected, because the cattle were primarily Limousin and Charolais cross.

Table 4. Effects of implant treatment on growth performance and carcass traits of finishing heifers.

Item	No implant	Component E-H plus Finaplix-H	Component E-H plus Component T-H	SE
Number of pens	4	8	8	
Number of cattle	40	78	79	
Initial wt, lb.	615	613	612	1
Final wt, lb.	1010[a]	1051[b]	1047[b]	9
Feed intake				
Days 1-28	15.99	15.86	15.30	.48
Days 29-56	17.09	17.86	17.79	.48
Days 57-84	17.06	18.15	17.77	.56
Days 85-112	18.45	19.88	18.76	.61
Days 113-139	19.10	20.12	19.88	.51
Overall, days 1-139	17.53	18.36	17.89	.37
Daily gain, lb.				
Days 1-28	2.75[a]	3.35[b]	3.28[b]	.10
Days 29-56	3.08[a]	3.46[b]	3.48[b]	.10
Days 57-84	2.73[a]	3.44[b]	3.43[b]	.14
Days 85-112	2.70	2.52	2.49	.21
Days 113-139	2.42[a]	2.76[b]	2.86[b]	.14
Overall, days 1-139	2.76[a]	3.13[b]	3.13[b]	.06
Feed/gain				
Days 1-28	5.81[a]	4.76[b]	4.66[b]	.13
Days 29-56	5.57	5.17	5.12	.15
Days 57-84	6.31[a]	5.28[b]	5.23[b]	.20
Days 85-112	6.87	8.04	7.75	.46
Days 113-139	7.61[a]	7.05[ab]	6.75[b]	.33
Overall, days 1-139	6.35[a]	5.87[b]	5.71[b]	.11
Carcass traits				
Dressing percent	61.61	61.75	61.59	.29
Carcass weight, lb.	623[a]	648[b]	645[b]	5.5
Marbling score[1]	2.65[a]	2.52[b]	2.60[ab]	.046
Percent choice	20	15	17.5	4.7
Lean maturity[2]	65.0[a]	72.1[b]	69.4[b]	1.37
Bone maturity[3]	73.8	72.6	72.4	1.13
Dark cutter score[4]	1.5	2.12	3.68	1.06
Dark cutters, %	2.5	7.5	10.0	3.9
Liver abscess score[5]	.05	.12	.17	.06
Liver abscess incidence, %	2.5[a]	7.5[ab]	8.7[b]	2.0
Carcass backfat, in	.25	.28	.31	.022
Ribeye area, sq in	13.87[a]	14.37[b]	14.45[b]	.145
Ribeye area/100# carcass	2.22	2.22	2.24	.02
KPH fat, %	2.39[a]	2.22[b]	2.24[b]	.052
Calculated yield grade	1.52	1.51	1.54	.075

[1] 0 to 90 = practically devoid, 100 to 190 = traces, 200 to 290 = slight, 300 to 390 = small, etc.
[2] 0 to 90 = "A" lean maturity, 100 to 190 = "B" lean maturity, etc.
[3] 0 to 90 = "A" bone maturity, 100 to 190 = "B" bone maturity, etc.
[4] Dark cutters were scored from 30 to 60% dark.
[5] 0 = no liver abscess, 1 = one small abscess, 2 = one medium abscess or two small abscesses, and 3 = one large abscess, several small abscesses or adhered to the body wall.
[ab] Means within a row with unlike superscripts are different, ($P < .10$).

Southwest Research-Extension Center

REPLACING SOYBEAN MEAL AND BEEF TALLOW WITH RAW SOYBEANS IN STEER FINISHING DIETS

by

Twig T. Marston, Kelly K. Kreikemeier, and James D. Swartwelle III

SUMMARY

Raw soybeans contain about 42% crude protein and 20% fat. Plant protein and added fat are expensive ingredients that are formulated into cattle finishing diets. Raw soybeans are not commonly fed to finishing cattle because of uncertainty over their feeding characteristics. This trial's objective was to determine if soybean meal and beef tallow could be replaced successfully with soybeans in finishing cattle diets. Steers weighing 690 lbs were fed one of four finishing diets for 137 days. Dietary treatments were: NEG containing 1.6% urea and 4% beef tallow; SBM containing 6% soybean meal and 4% beef tallow; DRB containing 7.5% dry-rolled soybeans and 2.5% beef tallow; and SFB containing 7.5% steam-flaked soybeans and 2.5% beef tallow. The SBM, DRB, and SFB diets also contained .6% urea; therefore, all diets were isonitrogenous and contained the same amount of dietary fat. No differences were noted in average daily gain, daily dry matter intake, and feed efficiency. Measured carcass traits were similar among treatments, except that SFB had a lower percentage of choice carcasses than NEG and DRB. These results indicate that soybeans with minimal processing can be substituted for soybean meal and beef tallow in cattle finishing diets that contain steam-flaked corn as the main grain source.

INTRODUCTION

For typical cattle finishing diets in the High Plains region, a premium is paid for natural protein (e.g. soybean meal or cottonseed meal) and high quality fat (beef tallow) sources. Whole soybeans contain about 42% crude protein and 20% fat but are not routinely fed to finishing cattle. Confusion exists over the effects of trypsin inhibitors, urease activity, and palatability characteristics of raw soybeans in finishing cattle diets.

A few reports discuss including early frosted, immature soybeans in forage-based diets for growing cattle. Apparently, animal performance is not reduced when soybeans constitute up to 10% of growing rations. This is likely due to the pregastric fermentation in the rumen. Rumen microorganisms apparently break down a large portion of the soybean protein and the trypsin inhibitor(s), therefore, only a small amount of these antinutritional factors flow to the small intestine.

Planting soybeans works well in several cropping systems across Kansas. Acres planted to soybeans in the state have remained constant, whereas acreage in western Kansas had declined 35% over the last 6 years. The poor economics for raising soybeans in western Kansas are due to two factors: 1) the placement of feedyards in western Kansas, which means that a premium is paid for feed grains and 2) the nearest soybean crushers being located in eastern Kansas, which adds transportation costs.

If raw soybeans could be included in finishing diets at 7.5% on a dry matter basis, they would replace all of the natural protein supplementation and nearly half of the added fat typically used in finishing diets. If animal performance does not decline from this ingredient substitution, a feedlot could afford to pay approximately $1.00 per bushel more for raw soybeans then what is currently bid to grain producers by local grain handling companies.

With these points in mind, the objective of this trial was to determine if raw soybeans could be substituted for soybean meal and beef tallow in a cattle finishing ration.

PROCEDURES

Two hundred crossbred steer calves (beginning weight = 690 lb) were assigned randomly to 20 pens, and pens were assigned randomly to treatments. The four dietary treatments were: negative control (NEG),

4% beef tallow and 1.6% urea; positive control (SBM), 6% soybean meal and 4% beef tallow; dry-rolled raw soybeans (DRB), 7.5% dry-rolled soybeans and 2.5% beef tallow; and steam-flaked soybeans (SFB), 7.5% steam-flaked soybeans and 2.5% beef tallow. The SBM, DRB, and SFB diets contained .6% urea originating from the supplement (Table 1). The dry-rolled and steam-flaked soybeans had a bulk density of 43 lb/bushels following processing, and the steam-flaked beans reached a temperature of 210°F just above the rolls. Steers used in this finishing study had been grown on a corn forage-based growing diet for about 120 days at an average daily gain of 1.5 lb/day just before this study. Steers were stepped up to final diets in 14 days using two step-up diets. Step-up one contained 40% corn silage, and step-up two contained 20% corn silage. Corn silage was substituted for the grain portion of the finishing diet. The final diet contained steam-flaked corn (95% total concentrate) for a total feeding period of 137 days starting on August 26, 1996. Steers were implanted with Synovex®-S (day 0) and Revalor®-S (day 50). Initial weight was based on the average of two consecutive daily weights (no shrink), and the final weight was based on hot carcass weight, adjusted to the common 64.05% dressing percent. Intermediate weights were recorded on days 50 and 100. Cattle were fed once daily in the morning. The goal was to offer feed such that the bunk was slick just before feeding, but cattle would come up to the bunk in a nonaggressive manner. The feed bunk was empty just before feeding on about 2 out of every 3 days. Individual carcass data were recorded, which included the incidence of liver abscesses, hot carcass weight, backfat, ribeye area, KPH fat depositions, and marbling score. USDA yield and quality grades were computed from the carcass data. Statistical data were analyzed consistant with a completely random design with pen mean as the experimental unit.

RESULTS AND DISCUSSION

Only minor statistical differences were found in animal performance between the finishing diets (Table 2). Final weights were similar for all treatments, with a tendency for the SFB-fed steers to be lighter than NEG- or DRB-fed steers (P = .13). Small variations in average daily gain were noted when recording intermediate and final weights, but no significant difference (P = .18) was noted for the entire feeding period. Interesting to note, the SFB-fed steers usually had the lowest daily gains, whereas DRB- and NEG-fed steers gained slightly more. Evaluating the diets with model 1 of the 1996 NRC (Table 1) showed that both the SFB and SBM diets were deficient in DIP, whereas the NEG and DRB diets were sufficient or

Table 1. Ingredient and nutrient compositions of the diets (dry matter basis, %).[1]

	Treatments			
Ingredient	Urea (NEG)	Soybean Meal Control (SBM)	Dry-Rolled Beans (DRB)	Steam-Flaked Beans (SFB)
Steam-flaked corn	86	81	81	81
Alfalfa hay	5	5	5	5
Soybean meal	0	6	0	0
Dry-rolled soybeans	0	0	7.5	0
Steam-flaked soybeans	0	0	0	7.5
Beef tallow	4	4	2.5	2.5
Supplement	5	4	4	4
Urea, % of diet	1.6	0.6	0.6	0.6
Nutrient content (book values from NRC, 1996)				
Crude protein, %	13.7	13.7	13.8	13.8
DIP, % crude protein	63.9	58.4	60.6	52.3
DIP balance (model 1), g	58.4	-12.8	0.2	-86.6
NEg, Mcal/lb	.64	.64	.64	.64

[1]Balanced to contain 14% CP, .7% K, .6% Ca, .4% and .2% Mg. Vitamins A, D, and E were included at 2,000, 200, and 20 IU per lb of diet DM. Rumensin and Tylan were fed at 30 and 10g/ton of diet DM.

Table 2. Treatment effects on body weight, gain, feed intake, and feed efficiency.

Items	Treatments NEG	SBM	DRB	SFB	SEM
In weight, lb	690	688	692	690	1.8
Final weight, lb	1142	1135	1153	1117	10.21
Average daily gain, lb/day					
Days 1- 50	4.40	4.31	4.38	4.08	.12
Days 51 - 100	3.41	3.35	3.46	3.18	.13
Days 101 - 137	1.55	1.65	1.82	1.67	.24
Days 1 -137	3.29	3.26	3.37	3.12	.08
Daily dry matter intakes, lb					
Days 1- 50	21.2	21.4	21.3	20.7	.31
Days 51 - 100	20.3	19.3	19.5	19.0	.61
Days 101 - 137	16.7	17.2	17.5	16.4	.49
Days 1 -137	19.9	19.6	19.8	18.9	.37
Feed/gain					
Days 1- 50	4.85	4.98	4.87	5.07	.16
Days 51 - 100	5.98	5.86	5.65	5.98	.29
Days 101 - 137	13.27	11.01	10.09	10.82	2.17
Days 1 -137	6.06	5.99	5.89	6.08	.11

contained excess DIP. Average daily gain may have been somewhat limited by inadequate DIP intake of the SBM and SFB diets.

No differences were measured in daily dry matter intake between the treatments (Table 2). Dry matter intakes were greatest during the first 50 days on feed and dramatically declined during the last 37 days on feed. We would expect some decline in DMI during the last portion of the finishing phase, but the degree of decline our cattle experienced suggests that some other factor(s), like weather, influenced feed intake. Feed conversion figures were quite respectable during the first 100 days on feed. Feed efficiency suffered for all treatments during the last 37 days on feed. That period reflected the increasing maintenance requirements coupled with reduced feed intake, which resulted in poor feed efficiency and animal performance. However, when averaged over the entire 137-day feeding period, animal performance and feed conversions were near expected results.

Carcass traits varied little between treatments (Table 3). Because no treatment differences were measured in ribeye area; fat thickness; hot carcass weight; or kidney, heart, and pelvic fat percentage, the USDA Yield Grades for treatments were similar. Average marbling scores were similar between treatments ($P = .17$), but the SFB treatment produced fewer USDA Choice or better carcasses than either the NEG or DRB treatments ($P < .05$). The SBM treatment was intermediate in percentage Choice. We do not know if this is a true biological phenomenon caused by diet composition differences.

Some discussion should be directed to the processing of raw soybeans. Dry-rolling soybeans to 43 lb/bushel test weight was quite easy on the rolling equipment and took minimal milling time. The same cannot be said about steam-flaking soybeans. During our first attempt to steam-flake, the application of steam quickly swelled soybeans to the point where the steam chest became plugged above the roller mill. Considerable time was needed to clean the system. Later, and more carefully, steam was applied to soybeans already flowing through the steam chest. Even when soybeans were steam-flaked to the same bushel weight achieved with the dry-rolling, processing time was extremely slow and milling efficiency was dramatically lowered.

Processing the soybeans allowed for adequate ration mixing. Differences in ration texture and condition appeared to be minimal and probably had no influence on dry matter intake. We feared that unprocessed raw soybeans would separate in the bunk, and animal sorting would occur. We observed little ration sorting in the bunk, but whether processing the beans had any influence on that was not measured. Also, ammonia release from the dietary urea because of the high urease activity in the raw soybeans was not observed.

This feeding trial shows that a significant portion of the finishing diet can be composed of raw soybeans. Because steam-flaked corn was the major starch source of the diet, the results of feeding soybeans with other grain sources or processing methods may have different results. Their complementary effect will probably depend on the amount and disappearance rate of the starch fractions, the presence of other sources of protein (nitrogen), and the balance and supply of DIP and UIP. Commodity pricing should allow cattle feeders the opportunity to lower feed costs through the use of raw soybeans.

Table 3. Treatment effects on carcass traits.

Item	Treatments				SEM
	NEG	SBM	DRB	SFB	
Hot carcass weight, lb	731	727	739	715	6.5
Fat thickness, in	.29	.27	.28	.31	.012
Rib eye area, sq in	13.5	13.4	13.2	13.1	.16
KPH fat, %	1.8	1.9	1.8	1.8	.05
USDA yield grade	1.34	1.35	1.44	1.46	.07
Marbling score*	320	302	334	304	10.8
Percent choice	59.3[a]	50.0[ab]	61.3[a]	40.0[b]	4.97

*Marbling score: 200 = Slight00, 300 = Small00, etc.
[ab]Means within rows with different superscripts differ (P < .05).

Southwest Research-Extension Center

THE EFFECTS OF SIMULTANEOUSLY INCREASING FAT AND PROTEIN LEVELS IN FINISHING CATTLE DIETS

by

Twig T. Marston, Kelly K. Kreikemeirer, and Gerry L. Kuhl

SUMMARY

The objective of this experiment was to determine if finishing cattle could be adapted successfully to diets containing high levels (8%) of added fat by increasing dietary protein concentration. Past research has indicated that feeding greater than 4 to 5% added fat in finishing diets does not work. With this in mind, maybe other nutrients, like protein, are limiting performance and may need to be increased in the diet to compensate for lower dry matter intakes. Steers (beginning weight =749 lb) were fed diets of either 4% added fat and 6% soybean meal (CONT) or a series of diets (STEPUP) that contained 0% added fat and 2% soybean meal for the first 30 days, after which each was increased 2% every 30 days. Therefore, during the last 30 days of the 150-day feeding period, the STEPUP diet contained 8% added fat and 10% soybean meal. Average daily gain for the entire feeding period was less for STEPUP versus CONT diets (3.26 vs 3.45 lb/d; -5.6%). This was mainly due to depressed gains of the STEPUP-fed steers during the first 30 days when their diets contained 0% added fat and only 2% soybean meal. Dry matter intake decreased with days on feed, and feed intake also declined when fat and protein were added to the diet. The CONT-fed steers had improved feed efficiency during the first 30 days but differences in feed efficiency were not significant during the remainder of the trial. No differences occurred in marbling scores or in internal or external fat stores; however, CONT-fed steers had heavier carcasses (826 vs 804 lb) than STEPUP-fed steers. Steers fed the STEPUP diets tended to have greater dressing percentage than CONT (65.02 vs 64.48%). Omitting the fat and soybean meal in the first 30 days of feeding depressed animal performance. In subsequent 30-day periods when fat was added at 2 to 8% and soybean meal was added at 4 to 10% of the diet, no differences in animal performance and feed efficiency were noted. Steers consuming diets containing 4% added fat had heavier carcasses, but other measured carcass traits were similar between treatments.

INTRODUCTION

Adding dietary fat is a common practice in the High Plains area. Previous research has noted that energy intake declines when too much fat (greater than 4 to 5%) is added to cattle finishing diets. Therefore, most High Plains feedlots formulate rations to contain between 2 to 4% added fat depending on least cost considerations. At times, when corn prices are extremely high, greater levels of fat in the diets could be economically feasible, if animal performance would not be compromised. Research from this center has focused on developing a feeding system that allows high levels of fat (up to 8%) to be incorporated into finishing rations. The objective of this trial was to determine if finishing cattle can be adapted to diets containing high levels of added fat by simultaneously increasing dietary protein concentration.

PROCEDURES

One hundred twenty crossbred steers (beginning weight = 749 lbs) were assigned randomly to 12 pens, which were assigned randomly to treatments (6 pens per treatment). Visual appraisal of these steers indicated mostly Continental and (or) Continental x English breeding. Steer age was probably at or less than a year of age at the beginning of the trial. Prior to the start of the finishing phase, steers gained approximately 1.75 lb/d on a high roughage type diet for about 200 days. Steers were placed on feed for 150 days starting on July 10, 1996. Treatments included a control diet (CONT) and a series of fat/soybean meal step-up diets (STEPUP). Diet compositions are shown in Table 1. The CONT diet contained 4% added beef tallow and 6% soybean meal, and the STEPUP treatment was a series of diets with beef tallow and soybean meal added in cumulative

increments of 2% every 30 days of feeding. Therefore, the STEPUP diet contained 0% beef tallow and 2% soybean meal for the first 30 days with subsequent monthly changes in diets so that the last ration fed contained 8% beef tallow and 10% soybean meal. The additions of fat and soybean meal were at the expense of steam-flaked corn. During the first 2 weeks of the feeding period, two step-up diets were used. Step one contained 30% corn silage plus 5% alfalfa hay, and step two contained 15% corn silage plus 5% alfalfa hay (dry matter basis). Feed was delivered once daily in the early morning. The average of two consecutive day's weights was used as the beginning live weight, and the final weight was determined as hot carcass weight divided by the average dressing percent (64.75%). Intermediate weights were recorded at 30-day intervals that coincided with the dietary changes in the STEPUP treatment. Steers were implanted with Synovex®-S on day 0 and Revalor®-S on day 60. Feed intake and efficiency were calculated on a pen basis. Individual carcass data were collected following a 24-hour chill. Statistically, data were analyzed as a completely random design. Each pen mean was the experimental unit.

RESULTS AND DISCUSSION

The final weight of CONT-fed steers was 33 lb more than that of STEPUP-fed steers (P = .03; Table 2). This was due to greater average daily gain by the CONT-fed steers during the first 30 days of the trial (4.21 vs. 3.51 lb/d). Other intermediate daily weight gains of CONT and STEPUP were similar throughout the rest of the trial. Nonetheless, average daily gain for the total feeding period was greater (P = .06) for the CONT (3.45 lb/d) than for STEPUP (3.26 lb/d) steers. Average daily gain decreased as days on feed progressed. Unlike previous research indicating that weight gains were depressed as added fat levels above 4% were fed, this experiment indicated that a portion of lost animal performance caused by high added dietary fat can be alleviated by increasing the soybean meal in the diet. Whether other protein sources containing various DIP and UIP levels would have a similar effect has not been tested. Our data show that compared to not adding fat, including 4% added fat in the diet during the first 30 days on feed provides a big advantage.

Dry matter intake was maximized when steers were fed diets containing 4% added fat. Steers fed CONT diets had significantly greater dry matter intakes (P = .03) than STEPUP steers in all months of the trial except the month when both treatments contained 4% added fat and 6% soybean meal (P = .74). Considering the time of year, condition of the steers, and past experience, average daily dry matter intakes for both treatments (17.28 lb/d, CONT; 16.50 lb/d, STEPUP) were lower than expected. Steers fed CONT diets during the first 30 days had 10.6% improved feed conversions compared to STEPUP steers (P < .01). Feed efficiency showed no difference during the remaining 120 days on fed or for the total feeding period (Table 2). Last year in a similar trial (where no adjustments were made in soybean meal content of the

Table 1. Ingredients and nutrient (NRC, 1996) compositions of finishing diets (DM basis) in the treatments.[1]

	Treatments					
	CONT	STEPUP				
Ingredient	1 - 150d	1 - 30d	31 - 60d	61 - 90d	91 - 120d	121 - 150d
Alfalfa hay	5	5	5	5	5	5
Steam-flaked corn	81	89	85	81	77	73
Soybean meal	6	2	4	6	8	10
Beef tallow	4	0	2	4	6	8
Mineral supplement	4	4	4	4	4	4
Nutrient						
CP, %	14.0	12.8	13.4	14.0	14.6	15.2
DIP, %CP	59.0	57.1	58.1	59.0	59.9	60.6
NEg, Mcal/lb	.71	.68	.70	.71	.73	.74

1 The control diet was formulated to contain 14% CP, .7% K, .6% Ca, .4% P, and .2% Mg. Vit A, D, and E were added at 2,000, 200, and 20 IU per lb of diet DM. Rumensin and Tylan were added at 30 and 10 g per ton of diet DM. A mineral supplement (containing feed additives) was fed at 4% of diet DM in all diets.

feeding period (Table 2). Last year in a similar trial (where no adjustments were made in soybean meal content of the diets), we reported similar patterns in dry matter intake and feed efficiency. In that trial, the depression in feed conversion during the first 30 days on feed was great enough to cause a difference in dry matter conversions for the entire 150-day feeding period.

Steers fed the CONT diets had greater (+21 lb; P = .03) hot carcass weights than STEPUP steers. However, because fat thickness and marbling scores were similar, steers from both treatments appeared to have been slaughtered at similar carcass composition end points. As in last year's study, steers fed the 8% added fat the last 30 days had a tendency towards greater dressing percentages (65.02%) than steers fed 4% fat (64.48%, P = .12). The difference in dressing percentage most likely was a function of gut fill.

Our data indicate that feeding 0% added fat and 2% soybean for the first 30 days of a finishing diet is likely to hinder animal performance, dry matter intake, and feed efficiency when compared to the industry standard diet with 4% added fat. If feedlots want to feed finishing diets containing added fat levels up to 8%, simultaneously increasing soybean meal content up to 10% of the diet will not maintain dry matter intake, but it may offset the full depression that would have occurred.

Fable 2. The effect of stepping up added fat and soybean meal on steer growth performance.[a]

Item	CONT	STEPUP	P value
In weight, lb	751	747	
Final weight, lb	1276	1243	0.03
Daily gain, lb			
Days 1 - 30	4.21	3.50	0.002
Days 31 - 60	3.94	3.96	0.96
Days 61 - 90	4.06	3.93	0.48
Days 91 - 120	2.88	2.74	0.36
Days 121 - 150	2.11	2.14	0.91
Days l-150	3.46	3.26	0.06
Dry matter intake, lb/d			
Days 1 - 30	15.85	14.59	0.001
Days 31 - 60	19.06	18.06	0.006
Days 61 - 90	18.31	18.18	0.74
Days 91 - 120	16.23	15.71	0.03
Days 121 - 150	17.06	16.05	0.05
Days l-150	17.28	16.50	0.002
Feed:gain, DM basis			
Days 1 - 30	3.77	4.17	0.01
Days 31 - 60	4.88	4.59	0.28
Days 61 - 90	4.52	4.65	0.49
Days 91 - 120	5.66	5.80	0.64
Days 121 - 150	8.46	7.66	0.41
Days l-150	5.01	5.06	0.68

[a]CONT = 4% beef tallow and 6% soybean meal fed continuouly. STEPUP = dietary beef tallow and soybean meal increased every 30 days.

Table 3. The effect of stepping up fat and soybean meal on carcass traits.

Item	CONT	STEPUP	Pvalue
Hot carcass weight, lb	826	805	0.03
Fat thickness, in	.38	.37	.64
Marbling score[b]	307	296	0.47

[a]CONT = 4% beef tallow and 6% soybean meal fed continuouly. STEPUP = dietary beef tallow and soybean meal increased every 30 days

[b]Marbling score: slight 00 = 200, Small 00 = 300

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EFFECTS OF RECONSTITUTING EARLY HARVESTED GRAIN SORGHUM ON FERMENTATION AND GROWTH PERFORMANCE AND CARCASS MERIT OF FINISHING HEIFERS

by

G. Lance Huck, Kelly K. Kreikemeier, and Keith K. Bolsen

SUMMARY

The objective was to determine if adding water to early harvested grain sorghum before ensiling affected ensiling fermentation characteristics or growth performance and carcass merit of finishing heifers. In experiment 1, grain sorghum was harvested at 14% moisture; rolled and reconstituted to either 25%, 30%, or 35% moisture; and then ensiled in laboratory-scale polyvinylchloride (PVC) silos. Lactic acid concentration increased more rapidly (day 5 to day 90) and pH declined more rapidly (day 3 to day 90) as moisture level increased (P <.05). Acetic acid concentration increased with moisture level and day of fermentation (P <.05). Concentrations of ethanol were highest (P < .05) for the 30% and 35% moisture treatments from day 1 to day 5, but by day 90, the levels of ethanol in the 25% moisture grain sorghum had exceeded (P <.05) those of the two wetter treatments. Ammonia concentrations were lowest (P <.05) at all sampling days in the 25% moisture grain sorghum. In Experiment 2, 288 heifers (BW = 630 lb) were used to compare the effects of feeding rolled, ensiled grain sorghum at harvest moisture level (25%) or reconstituted to 30% or 35% moisture. A steam-flaked corn-based finishing diet served as the control. Ending weight, daily gain, hot carcass weight, fat thickness, liver abscess scores, marbling score, and KPH fat were not affected by treatment (P > .05). Dry matter intake was highest (P <.05) for heifers offered 25% or 30% moisture grain sorghum and lowest for those offered steam-flaked corn, with intakes of heifers offered 35% moisture grain sorghum being intermediate. Feeding 35% moisture grain sorghum significantly (P <.05) improved feed efficiency compared to feeding 25% or 30% moisture grain sorghum by 9% and 5.7%, respectively. We conclude that reconstituting grain sorghum beyond typical moisture levels of 28 to 30% can enhance in-silo fermentation characteristics and improve feed efficiency of heifers.

INTRODUCTION

The popularity of grain sorghum in finishing diets is proportional to its price structure relative to corn and a feedlot's capability to either steam-flake, early-harvest, or reconstitute grain. Typically, grain sorghum is priced at 87 to 90% of the value of corn partly because of a disparity in feedlot performance observed when the two grains are compared. When grain sorghum is processed using wet methods, such as steam-flaking, early-harvesting, or reconstituting, improvements in feed efficiency of 12 to 15% occur. Ensiling high-moisture grain sorghum seems logical, because it gives the feedlot the option to feed a rapidly fermentable grain source that doesn't require steam-flaking. To ensure success, research has indicated that the most ideal moisture level at which to harvest and ensile early harvested grain sorghum is 26 to 30%. Unless ideal weather conditions prevail during the harvest, grain sorghum has a very narrow harvest window because of rapid dry-down in the field. To remedy this, a producer will have to add water back to the grain as harvest progresses. Little is known regarding the fermentation and feeding value of high-moisture grain sorghum when the moisture level is increased to levels beyond 30%. Therefore, the objective of this experiment was to examine the effects of increasing the moisture level of early harvested grain sorghum on: 1) fermentation in laboratory scale silos and 2) growth performance and carcass characteristics of finishing heifers.

PROCEDURES

Trial 1. Harvest and Storage Procedures. In the fall of 1995, a sample from one field of grain sorghum (GS) DK-41Y, was harvested at 14% moisture.

Immediately after harvesting, GS was rolled through a Rosskamp roller mill so that no whole grains were present in the rolled sample. Reconstitution of dry grain was accomplished by mixing the GS with a predetermined amount of water in a portable cement mixer. Grain sorghum was reconstituted to either 25, 30, or 35% moisture. All samples were ensiled in 4 inch by 7 inch PVC laboratory silos and packed to the same density using a hydraulic press. Each silo was equipped with a Bunsen valve at one end, which excluded air but enabled gases to escape. Silos were stored at ambient temperature (80°F). Three silos per treatment were opened on days 1, 3, 5, 10, and 90 postensiling and subsampled; then subsamples were frozen for later analysis.

Laboratory Analysis. Grain sorghum samples were thawed, dried in a forced air oven at 55°C, and analyzed for dry matter (DM). Other analyses were conducted on thawed nondried samples. A 25 g aliquot of fresh, frozen, ensiled grain was combined with 250 ml of distilled, deionized, water for 2 h and strained through four layers of cheesecloth; then pH was determined. Another 25 g sample was extracted in 200 ml of .2 N H_2SO_4 for 2 days and strained through four layers of cheesecloth. The supernate was retained and used to measure ammonia, lactic acid, volatile fatty acids, and ethanol.

Statistical Analysis. Data were analyzed using GLM procedures of SAS. For data on PVC silos, each silo served as an observation, and those data were analyzed as a completely random design with a 3 by 5 factorial arrangement of treatments (moisture level and day of fermentation). All data are presented in figures. If the interaction was significant ($P < .05$), differences between moisture level within day of fermentation are noted. If the interaction was not significant ($P > .05$), statistical differences are presented across the main effects of moisture level and day of fermentation.

Trial 2. Animals. Two hundred eighty-eight heifers (BW = 630 lbs) were used to evaluate feeding increasing moisture levels of reconstituted, early harvested, grain sorghum (HMGS). Heifers appeared to be crossbreds of Limousin and Charolais parentage. Animals were allotted to one of two weight blocks, and treatments were allotted randomly to pens within each block. The heavy block (BW = 677 lbs) included 144 head assigned randomly to 16 pens for a total of nine head per pen. The light group (BW = 584 lbs) consisted of 144 head assigned randomly to 12 pens for a total of 12 head per pen. The heavy group of heifers was placed in pens with concrete flooring, which provided 24 inches of linear bunk space and 70 square ft of pen area per animal. The light group was placed in open-lot dirt pens with a concrete feeding apron, which provided 18 inches of linear bunk space and 160 square ft of pen area per heifer. Heifers were implanted initially with Implus-H and re-implanted with Revalor-H on day 60 of the feeding period. The heavy group was fed for 147 days, and the light group for 169 days. Then, cattle were slaughtered, and carcass data collected.

Diets. Treatments were based on four grain sources. The diets were 1) steam-flaked corn (SFC), which served as the control; 2) HMGS harvested at 25% moisture, rolled, and ensiled **(25);** 3) treatment 2, but reconstituted to 30% moisture and ensiled **(30),** and 4) treatment 2, but reconstituted to 35% moisture and ensiled **(35).** Steam-flaked corn was flaked to 30 lbs per bushel, retention time in the chest was approximately 20 minutes, temperature above the rolls was 2l0°F, and moisture level of the fresh flake was 19 to 20%. All grain sorghum (GS) was from a single source and rolled through a single-stage roller mill (8 cuts/in). Next, a predetermined amount of rolled GS was loaded into an auger type feed mixer, mixed for 2 minutes with the correct amount of water, then unloaded and packed into a bunker silo. Dimensions of the packed grain were 12 ft wide, 4 ft high, and 70 ft long. All silos were covered with polyethylene and weighted with tires. During the feeding portion, we fed just less than 6 inches of linear length off of the face of each silo, daily.

Cattle were stepped up to their final diet in 14 days using two step-up diets. Step one was fed from days l-7 and contained 40% corn silage, and step two was fed from days 8- 14 and contained 25% corn silage (DM basis). The final diets (Table 1) contained 78% grain, 10% corn silage, 6% soybean meal. 3% beef tallow, and 3% finisher supplement. Cattle were fed once daily in the morning, such that the bunk was slick just before feedings, but they were not hungry. The bunk was empty just before feeding on 2 out of every 3 days.

Response Criterion. Beginning weights were based on two consecutive daily weights. Ending weight was determined by adjusting hot carcass weights to a 62% dressing percent; then gain, DM intake, and feed/gain were determined for each pen. After the carcasses were chilled for 24 h, subcutaneous fat depth over the longissimus muscle at the 12th rib and

Table 1. Compositions of diets fed in the cattle finishing experiment[1].

Ingredient	Treatment 25	30	35	SFC
Early harvested grain sorghum, 25% moisture	78			
Reconstituted grain sorghum, 30% moisture		78		
Reconstituted grain sorghum, 35% moisture			78	
Steam-flaked corn				78
Corn silage	10	10	10	10
Soybean meal	6	6	6	6
Beef tallow	3	3	3	3
Urea	.694	.694	.694	.694
Dicalcium phosphate	.495	.495	.495	.495
Limestone	1.114	1.114	1.114	1.114
Potassium chloride	.163	.163	.163	.163
Salt	.3	.3	.3	.3
Magnesium oxide	.111	.111	.111	.111
Rumensin 80[2]	.0187	.0187	.0187	.0187
Tylan 100[3]	.005	.005	.005	.005
Vitamins ADE premix[4]	.01	.01.	.01	.01
Mineral oil	.03	.03	.03	.03
Trace mineral premix[5]	.06	.06	.06	.06

[1]Dry matter basis.
[2]Fed at 30 g/ton of diet DM.
[3] Fed at 10 g/ton of diet DM..
[4]Added to the diet so that each lb of diet DM contained 2000 IU vitamin A, 200 IU vitamin D and 20 IU vitamin E.
[5]Contained (g/kg premix) 55 Ca, 5 Co, 24 Cu, 1.6 I, 40 Fe, 160 Mn, .8 Se, and 240 Zn .

USDA marbling score (USDA, 1989) were determined.

Statistical Analysis. For animal performance and carcass measures, the pen mean was the statistical observation. Data were analyzed using GLM procedures of SAS. The statistical model used was a randomized complete block design.

RESULTS AND DISCUSSION

Trial 1. Overall, means for pH declined from 6.6 on d 1 to 4.4 on day 90 (Figure 1). A moisture level by day of fermentation interaction occurred (P <.01), because the pH of all moisture levels were similar at day 1, but pH was lowest from day 3 through 90 for **35,** followed by **30,** and highest for **25** (P <.05). A moisture level by day of fermentation interaction also occurred for lactate concentration (Figure 2). Lactate concentration increased from .002% of DM on day 1 to 1.1% on day 90. Means for moisture levels did not differ on day 1 or 3, but from day 5 through day 90, **35** had the

Fig. 1. Effects of moisture level and day of fermentation on pH of high-moisture grain sorghum. Moisture x day of fermentation interaction, P < .01, SE= .05. Moisture level means within day of fermentation with unlike letters are different, P < .05.

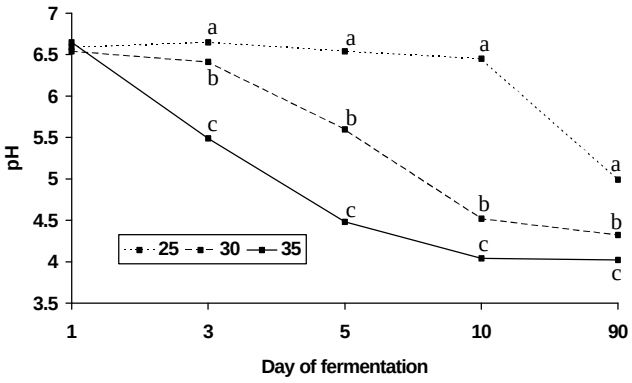
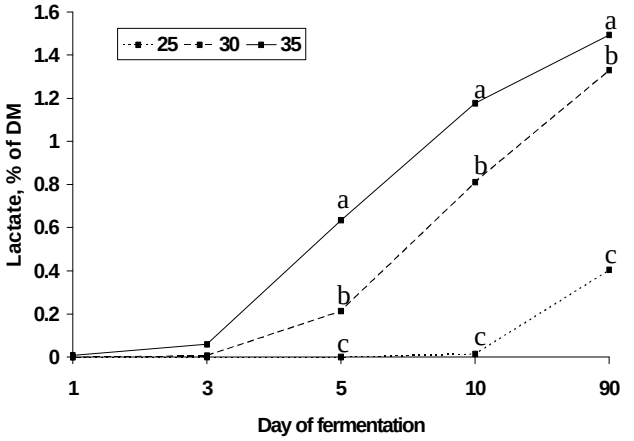


Fig. 2. Effects of moisture level and day of fermentation on lactate concentration of high-moisture grain sorghum. Moisture x day of fermentation interaction, P < .01, SE = .05. Moisture level means within day of fermentation with unlike letters are different, P < .05.



greatest concentration, followed by **30**, and the lowest lactate concentrations for **25** (P <.05). The concentration of acetate increased with day of fermentation for all moisture levels (P <.05; Figure 3). Overall acetate content was higher for **35** than **25** (P <.05), but neither moisture level mean was different than that for **30** (P >.05). The ratio of lactic to acetic acid was similar among moisture levels (P >.05, Figure 4) and followed a similar pattern to acetate concentration that increased (P <.05) over time. A moisture level by day of fermentation interaction occurred (P < .01, Figure 5) for ethanol concentrations. Treatments **30** and **35** were higher (P < .05) than **25** on day 3 and 5. On day 10, **25** and **35** were similar (P > .05), and ethanol concentration of moisture level **30** was greatest (P < .05). At some point between day 10 and day 90, ethanol concentration peaked for the two higher moisture levels, whereas ethanol levels continued to increase in treatment **25** during this period. This led to a reversal in levels of ethanol present at day 90 compared to earlier in the fermentation period; **30** and **35** were similar to each other but significantly lower than **25** (P < .05). Although levels were extremely low, the concentration of NH_3 increased from .004% of DM on day 1, to .04 % on day 90 (Figure 6). A moisture level by day of fermentation interaction was present, because means were similar (P > .05) on day 1 but **30** and **35** were higher (P < .05) than **25** by day 3 and remained higher throughout the fermentation period. Overall, data incidate that the wetter the sorghum, the more rapid the fermentation. This is considered desirable, because increased acid production combined with reduced time to reach pH 4.0 indicates a reduction in primary fermentation time, which restricts secondary fermentation processes.

Fig. 3. Effects of moisture level and day of fermentation on acetate concentration of high moisture grain sorghum. Moisture x day of fermentation interaction, P = .35, SE = .05; main effect of day of fermentation, P < .01, SE = >02; main effect of moisture level, P =.04, SE .02. Means for day of fermentation for days 1, 3, 5, 10, and 90 are 0, 0, .02, .12, and .28: LSD = .08, P < .05. Means for moisture levels 25, 30, and 35% are .05, .08, .13; LSD = .07, P <.05.

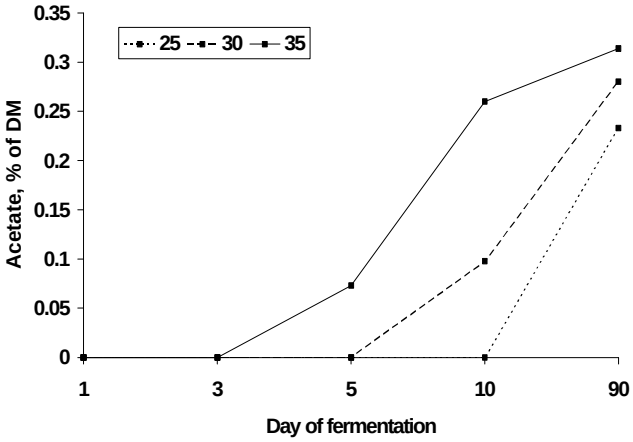
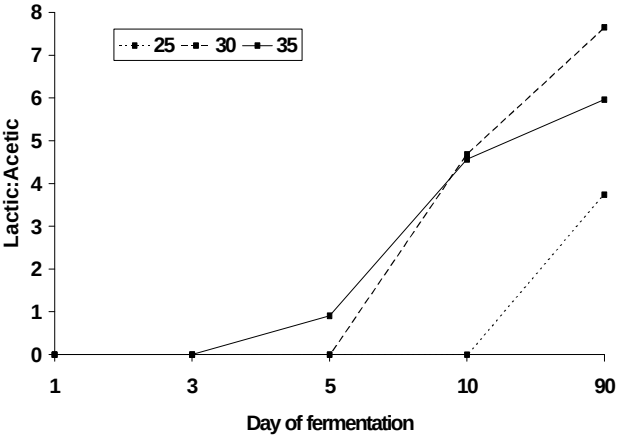


Fig. 4. Effects of moisture level and day of fermentation on lactate to acetate ratio of high moisture grain sorghum. Moisture x day of fermentation interaction, P = .74, SE = .003; main effect of day of fermentation, P < .01, SE = .94; main effect of moisture level, P = .21, SE = .73. Means for day of fermentation for days 1, 3, 5, 10, and 90 are 0, 0, .30, 3.08, and 5.78; LSD = 2.11, P < .05.



Trial 2. Feedlot Performance. Heifers averaged 631 lb at the beginning of the trial and were fed for an average of 158 days (Table 2). At the end of the study, heifers averaged 1087 lb with no difference among treatments (P > .05). Likewise, average daily gains were similar among treatments (P > .05). They increased numerically as GS moisture level increased,

Fig. 5. Effects of moisture level and day of fermentation on ethanol concentration of high-moisture grain sorghum. Moisture x day of fermentation interaction, P < .01, SE = .04. Moisture level means within day of fermentation with unlike letters are different, P < .05.

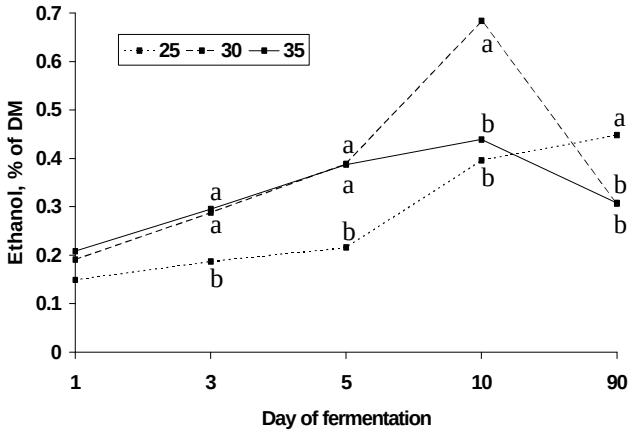
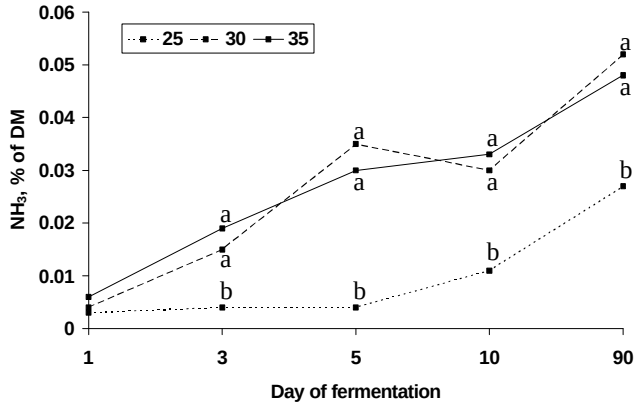


Fig. 6. Effects of moisture level and day of fermentation on NH_3 levels of high-moisture grain sorghum. Moisture x day of fermentation interaction, P < .01, SE = .003. Moisture level means within day of fermentation with unlike letters are different, P < .05.



but did not exceed gains from heifers offered the SFC-based diet. Dry matter intakes were highest when heifers were offered **25** or **30** diets, lowest for the SFC-based diet, and intermediate for the **35** diet ($P < .05$). Others have reported DMI decreases with increased moisture level of reconstituted grain sorghum. Feed efficiency was similar between heifers offered SFC and **35** ($P > .05$) and significantly better ($P < .05$) than feed efficiency of cattle fed **25** or **30**. Numerous trials have shown a positive relationship between feed efficiency and grain moisture content with corn and grain sorghum, but few trials have examined the effect of moisture level on performance when grain moisture was reconstituted to 35%.

Carcass Merit. Hot carcass weight averaged 676 lb and did not differ among treatments ($P < .05$, Table 3). Treatment did not affect ($P > .05$) fat thickness, liver abscess score, USDA marbling score, or KPH fat.

Overall. In this experiment, reconstituting early harvested sorghum to 35% moisture improved its feeding value to 96% that of steam-flaked corn. In two previous studies conducted here at SWREC, steam-flaked sorghum had feeding values of 85 and 96% of steam-flaked corn, and that is reflected in the marketplace. Why reconstituting to 35% moisture was so favorable could be attributed to two factors. First, increased moisture resulted in a more rapid ensiling fermentation. This restricts secondary fermentation losses; therefore, more feed nutrients are conserved. The second factor relates to the availability of starch in sorghum to the ruminal microflora. The starch protein matrix in sorghum is very strong. As a result, this renders the starch granules in sorghum less available to the ruminal microflora as compared to other feed grains. We also know that ensiling solubilizes feed protein to various extents, but protein solubility increases with greater moisture and longer length of ensiling. Reports in the literature suggest that with corn containing over 30% moisture and ensiled for over 200 days, as much as 60% of the total protein is soluble. If increased moisture in this experiment caused increased protein solubilization in the grain sorghum, we would expect an increase in ruminal starch fermentation and, hence, increased digestibility and improved feed efficiency.

Table 2. Effects of moisture level of grain sorghum at the time of ensiling on feedlot performance of heifers.

Item	Moisture, %[1] 25	30	35	SFC[2]	SE	P-value[3]
Initial wt, lb	633	630	630	633	1.8	.28
Final wt, lb	1078	1089	1093	1104	7.6	.13
DM intake, lb/d	18.3[a]	18.3[a]	17.6[ab]	17.0[b]	.26	.01
Gain, lb/d	2.82	2.91	2.95	3.00	.04	.09
Feed/gain	6.49[a]	6.29[a]	5.95[b]	5.71[b]	.008	.01

[1]Moisture content of early harvested and ensiled grain sorghum. Sorghum harvested at 25% moisture and reconstituted to either 30 or 35% moisture.
[2]SFC = Steam-flaked corn.
[3]Probability that treatment means are similar.
[abc]Means with unlike superscripts differ, P < .05.

Table 3. Effects of moisture level of grain sorghum at the time of ensiling on carcass characteristics of heifers.

Item	Moisture, %[1] 25	30	35	SFC[2]	SE	P-value[3]
Hot carcass wt., lb	668	674	679	685	4.6	.13
Fat thickness, in	.26	.28	.26	.31	.04	.10
Liver abscess score[4]	0	0	.03	0	.02	.42
USDA marbling score[5]	264	255	263	284	10.5	.29
KPH fat, %	2.02	1.90	1.98	2.04	.05	.22

[1]Moisture content of early harvested and ensiled grain sorghum. Sorghum harvested at 25% moisture and reconstituted to either 30 or 35% moisture.
[2]SFC = Steam-flaked corn.
[3]Probability that treatment means are similar.
[4]0 = no liver abscess, 1 = 1 small abscess.
[5]0 - 90 = Practically devoid, 100 - 190 = Traces, 200 - 299 = Slight, 300 - 399 = Small.

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EFFECTS OF TREATING HIGH-MOISTURE CORN WITH A BACTERIAL INOCULANT CONTAINING LACTOBACILLUS BUCHNERI ON ENSILING FERMENTATION CHARACTERISTICS AND AEROBIC STABILITY

by

Kelly K. Kreikemeier and Todd P. Trooien

SUMMARY

High-moisture corn (33% moisture) was harvested, rolled, inoculated with *Lactobacillus buchneri,* and ensiled in small PVC silos and 55- gallon drum silos. The objective was to determine if the inoculant showed any benefit in terms of ensiling fermentation efficiency or improved aerobic stability of the high-moisture corn. In general, we saw no evidence that innoculating high-moisture corn with *Lactobacillus buchneri* gave any improvement in fermentation efficiency over corn that was not inoculated. Similarly, this inoculant showed little benefit in improving aerobic stability of high-moisture corn.

INTRODUCTION

Improving silage quality by utilizing a bacterial inoculant at ensiling time has been the focus of research for several years. The objective is to add sufficient numbers of homofermentative lactic-acid producing bacteria in order to dominate the fermentation and produce primarily lactic acid. If a sufficient quantity of lactic acid is produced, it inhibits the epiphytic microorganisms and the activity of endogenous plant catabolic enzymes. Lactic acid is a more efficient end product of fermentation because it is a stronger acid compared to other organic acids produced by the mixed population of epiphytic microorganisms.

There is little doubt that silages with greater lactic acid concentrations have reduced storage losses. However, reports have suggested that a microbial inoculation that stimulates a homolactic fermentation may have decreased aerobic stability. As a result, some inoculants have included "propionibacterium", a bacterium that promotes production of greater amounts of propionic acid during the ensiling process. In turn, the propionic acid should restrict processes that cause aerobic deterioration during feedout. Research here has led to favorable results in high- moisture corn, whereas others have reported mixed results. This study evaluated *Lactobacillus buchneri*, a bacterium that is involved in the conversion of lactic acid to other volatile fatty acids, most notably, acetic acid. The objective was to use it as an inoculant in high-moisture corn to see if it increased aerobic stability.

PROCEDURES

Corn Harvesting and Inoculant. The inoculant, *Lactobacillus buchneri*, was provided to us by Biotal Inc. (Eden Prairie, MN). It was rehydrated in lukewarm tap water and applied to high-moisture corn at either 50,000 or 100,000 colony forming units (cfu) per gram of feed. The third treatment (control) had no bacterial inoculant.

Corn was harvested in October, 1996 when it contained 33% moisture. It was rolled coarsely with a roller mill that had 4 cuts per inch. Four thousand lbs of corn were rolled (as-is basis) onto a feed truck that contained three horizontal mixing augers. The correct amount of bacterial inoculant (2 g) was dissolved in 2 quarts of tap water and applied to the corn while it was mixing. The load then was mixed for 5 minutes, and approximately 500 lbs were unloaded off the wagon and discarded. Then we started filling PVC silos. In order to prevent cross-contamination, we processed the three treatments in the following order, load 1) no inoculant (control), load 2) corn inoculated with 50,000 cfu/g feedstuff, and load 3) corn inoculated with 100,000 cfu/g feedstuff.

Filling PVC Silos. Control corn and inoculated high-moisture corn were put into small polyvinyl chloride (PVC) silos and allowed to ferment. Silos were opened at various times to determine the effect of the inoculant on fermentation characteristics. The silos had an internal diameter of 4 inches, and they were 12 inches long. They were fitted on one end with a rubber cap that was fastened to the silo by tightening a radiator

clamp on the outside. High-moisture corn was added and compacted. This was done by filling a PVC silo ¾ full, compacting the entire surface with a plate at the end of a hydraulic press, applying 1200 lbs of pressure, and maintaining the pressure for 10 sec Then a sleeve was fitted over the top of the silo (10 inches long), and corn was added to the sleeve until it was about 4 inches above the top of the PVC silo. Pressure was applied as before, the sleeve was removed, and excess corn was removed even with the top of the PVC silo.

The tops of the PVC silos were capped in the same way as the bottoms, and the silos were stored at 70° F. The top of each silo was vented using a short stem of Teflon tubing attached to a rubber policeman that contained a small slit. The Teflon tubing stem was inserted into and through the top rubber cap. In this manner, fermentation gasses could escape without allowing oxygen penetration into the PVC silo.

A total of 90 silos was filled; 30 for each treatment. Six PVC silos of each grain were opened at days 1, 4, 7, 21, and 90 after filling. The PVC silo was opened and emptied, then the grain was subsampled and stored frozen for subsequent laboratory analysis.

Filling Drum Silos. After PVC silos were filled, the corn remaining was ensiled in 55-gallon oil drums, from which the tops and sharp edges had been removed. Large 10 ml plastic bags were placed inside the drums, and the tops of the bags were folded down over the outside top of the drums. Corn was placed inside the drum to a height of just over half full. Then a 30-gallon drum (both ends intact) was placed vertically on top of the corn, and 1500 lbs of pressure was applied downward on top of the corn to pack it. Then, pressure and the 30-gallon drum were removed, and corn was added to about 6 inches below the top of the barrel silo and packed as just described. Then, the top of the plastic liner was lifted up, brought together and twisted to remove air, and wrapped with tape around the "neck" to seal it off. Using this protocol, each drum contained approximately 300 lbs of corn (as-is basis). Drums were stored in a covered shed and exposed to ambient temperature. A total of 18 drums was filled, six for each treatment. After 120 days of storage, these silos were opened to determine aerobic stability.

Three drum silos (one from each treatment) were brought into the laboratory and exposed to an ambient temperature of 87° F. After 96 hours, silos were opened, and corn was transferred to an empty 55-gallon drum till it was 2/3 full. This barrel was wrapped with R-13 fiberglass insulation, and corn was covered with a 2-inch-thick circular piece of Styrofoam. A thermometer was inserted through the center of the Styrofoam into the corn so the thermometer bulb was 2 inches below the surface of the corn. Temperature was read at time 0 and every 24 hours thereafter for 96 hours. Coinciding with recording temperature of the corn, a 200-gram sample was collected and stored frozen for later analysis.

Corn samples were collected as follows. With the Styrofoam covering the corn, we cut five circles of 4-inch diameter, such that the "cuts" could be lifted out or set back in place. For sampling, a "cut" was removed and an aluminum cylinder (4 inches wide, 6 inches long) was inserted 6 inches into the corn so that the top of the cylinder was even with the top of the corn. Then, 200 grams of corn were removed, and the Styrofoam lid was put back in place. In this manner, the disturbance for sampling did not affect the rate of heating of high-moisture corn in the drum.

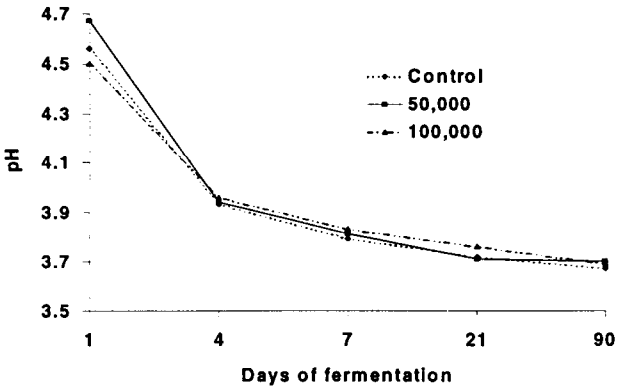
Laboratory Analysis. Corn samples were thawed, dried in a forced air oven at 131° F, and analyzed for dry matter (DM). Other analyses were conducted on thawed nondried sample, including pH, total N, soluble N, ammonia-N, lactate, acetate, propionate, and ethanol.

Statistical Analysis. For data on PVC silos, each silo served as an observation, and those data were analyzed as a completely random design with a 3 by 5 factorial arrangement of treatments (inoculant and day of fermentation). Data collected from drum silos were analyzed using a split-plot analysis. The whole-plot factor was inoculant, and each silo served as the observation. The subplot factor was time, and each sample collected was an observation. The model used included inoculant, inoculant nested within replication, time, and the inoculant by time interaction. The sum of squares due to inoculant nested within replication was used as the whole-plot error term to test for significance of inoculant. Data are presented graphically, and statistical significance between treatments is given only if a main effect or the interaction was significant ($P < .05$).

RESULTS AND DISCUSSION

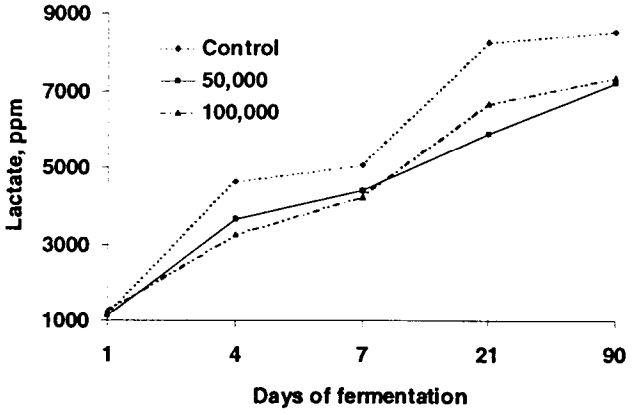
Fermentation Characteristics of Ensiled Corn in PVC Silos. pH of the ensiled high-moisture corn decreased over time ($P < .01$; Figure 1) but inoculant ($P=.42$)

Fig. 1. Effects of inoculant and days of fermentation on pH of corn ensiled in PVC silos. Effect of days of fermentation, P < .0l.



had no effect. Lactate concentration increased over time (P < .0l; Figure 2) and was greater in control corn compared to inoculated corn from day 4 to day 90 (P < .0l). Ammonia concentrations increased over time (P < .0l ; Figure 3) and were less in control than inoculated corn (P < .0l). Soluble protein increased with days of fermentation (P < .01; Figure 4) but was not affected by inoculation (P =.11). Numerically, ethanol concentration increased over time (Figure 5) but an inoculation by days of fermentation interaction (P < .0l) occurred. This was due to ethanol concentration being higher (P < .0l) in control corn than inoculated corn at day 7. Acetate concentrations increased with days of fermentation (P < .0l; Figure 6), but inoculation had no effect (P = .61). Propionate concentrations were low (.03% of DM) and unaffected by either inoculant (P = .44) or days of fermentation (P =.22; data not shown).

Fig. 2. Effects of inoculant and days of fermentation on lactate concentration of corn ensiled in PVC silos. Effects of days of fermentation, P < .0l. Effect of inoculant, P < .0l.



Aerobic Stability of Corn in Barrel Silos. After exposure to air, temperatures in all corn samples increased by 68°F relative to initial temperature (P <

Fig. 3. Effects of inoculant and days of fermentation on ammonia concentrations in corn ensiled in PVC silos. Effect of days of fermentation, P < .01. Effect of innoculant, P < .01.

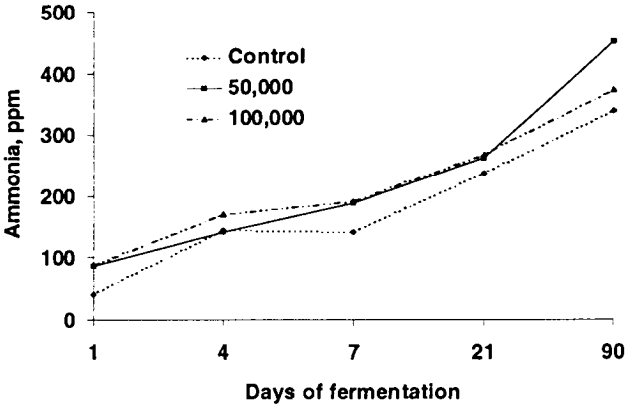


Fig. 4. Effects of inoculant and days of fermentation on soluble protein in corn ensiled in PVC silos. Effect of days of fermentation, P < .0l.

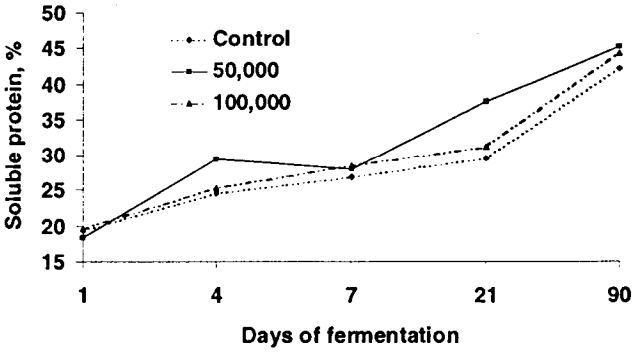
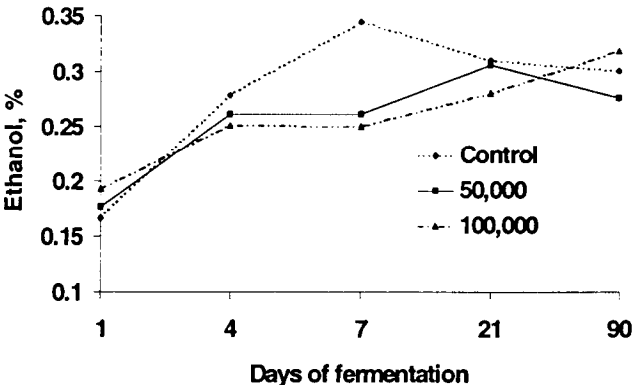


Fig. 5. Effects of inoculant and days of fermentation on ethanol concentration in corn ensiled in PVC silos. Inoculant by days of fermentation interaction, P < .0l. Within day 7, ethanol of control corn is greater than inoculated corn, P < .0l.



.0l; Figure 7). Numerically, inoculated corn heated less through 24 hours and maintained a lower temperature through 48 hours compared to control corn. However, because the interaction (inoculation by hours after opening) was not significant (P = .34), treatment mean differences within a given time period may not be “real”.

Fig. 6. Effects of inoculant and days of fermentation on acetate concentration in corn ensiled in PVC silos. Effect of days of fermenation, P < .0l.

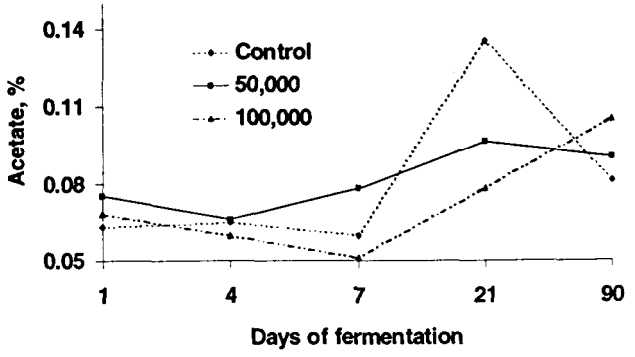
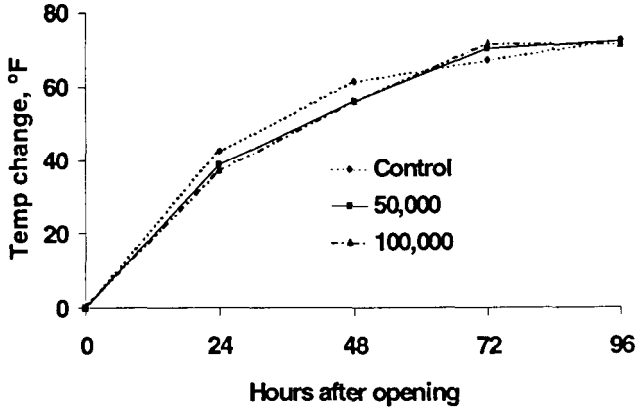


Fig. 7. Effects of inoculant and hours after opening on the increase in temperature of corn ensiled in drum silos. Effect of hours after opening, P < .0l.



The pH of corn increased from 3.98 at opening to 4.08 at 96 hours after opening (P < .0l; Figure 8), with no effect from inoculant (P = .53). Lactate concentration was not affected by inoculation (P = .35; Figure 9). Its concentration was relatively stable through 72 hours and then declined from 72 to 96 hours of air exposure (P < .0l). In the results with corn from PVC silos, lactate concentrations were greater in control corn than inoculated corn through all 90 days. Ensiled corn in drum silos and PVC silos differed in length of ensiling (up to 90 days vs 120 days), and drums were exposed to cooler temperatures than PVC silos. Also, because lactic acid is volatile, it is interesting to note that lactate concentration did not begin to decline till after 72 hours of air exposure. If initial volatilization of lactate occurred, then facultative microflora may have continued to metabolize readily available sugars, with lactic acid as a dominant end product.

Fig. 8. Effects of inoculant and hours after opening on pH of corn ensiled in drum silos. Effect of hours after opening, P < .0l.

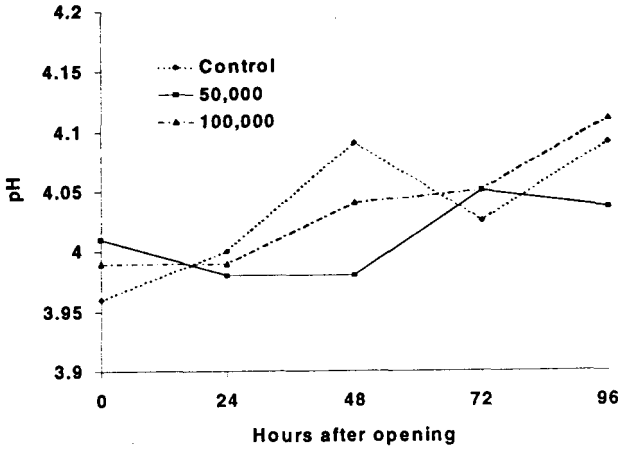
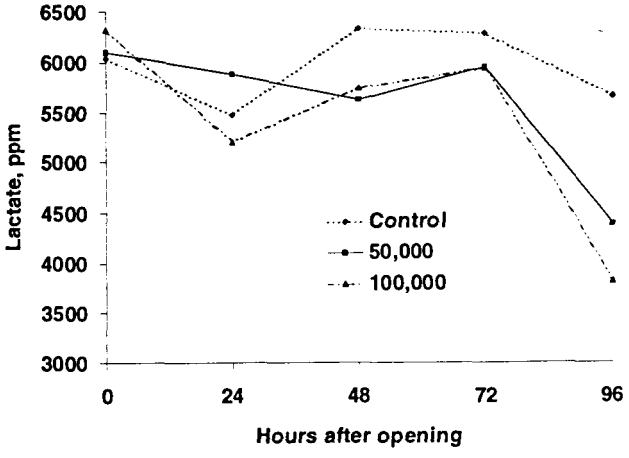


Fig. 9. Effects of inoculant and hours after opening on lactate concentration in corn ensiled in drum silos. Effect of hours after opening, P < .0l.



Ammonia concentrations were relatively stable after opening (P = .74; Figure 10), but ammonia was higher in inoculated corn (P = .02) than control. Soluble protein increased with hours after opening (P < .0l; Figure 11) but was not affected by inoculant (P = .67). The increase in soluble protein with air exposure indicates that protein degradation, or at least partial hydrolysis, occurred during aerobic deterioration.

Ethanol concentration decreased with hours after opening (P < .0l; Figure 12), and it was higher in inoculated corn than control (P < .0l). Because ethanol has such a high buffering capacity, we think it is undesirable as a fermentation end product. At opening, ethanol concentrations were similar across treatments. We do not know why ethanol concentrations remained higher in inoculated corn

Fig. 10. Effects of inoculant and hours after opening on ammonia concentration of corn ensiled in drum silos. Effect of innoculant, P = .02.

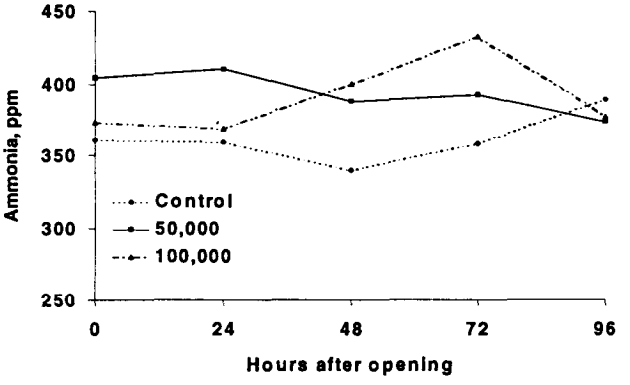


Fig. 11. Effects of inoculant and hours after opening on soluble protein of corn ensiled in drum silos. Effect of hours after opening, P < .0l.

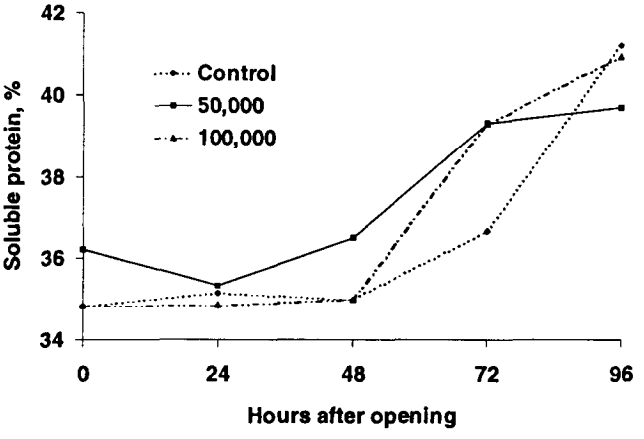
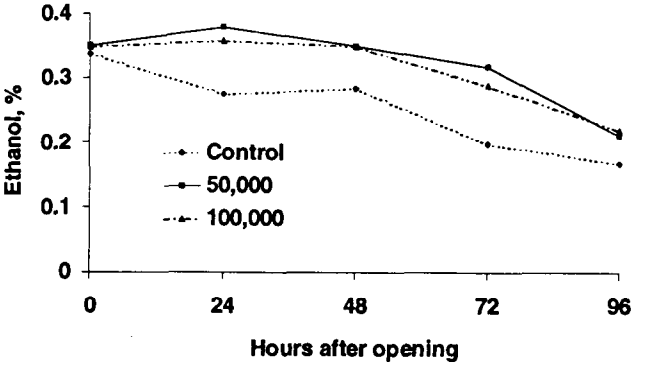


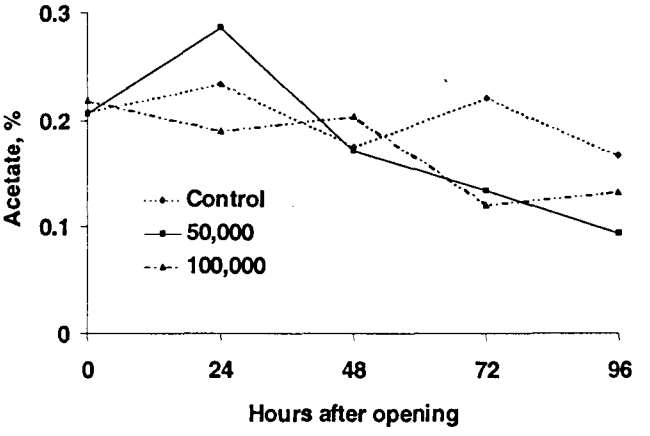
Fig. 12. Effects of inoculant and hours after opening on ethanol concentration of corn ensiled in drum silos. Effect of inoculant, P < .0l. Effect of hours after opening, P < .0l.



during exposure to air or whether this observation is meaningful.

Acetate concentrations decreased with hours after opening (P = .02; Figure 13), and inoculant had no effect (P = .41). Similar to corn ensiled in PVC silos, corn ensiled in drum silos had very low propionate concentrations (< .0l % of dry matter; data not shown), and inoculant (P = .82) or hours after opening occurred (P = .28) had no effect.

Fig. 13. Effects of inoculant and hours after opening on acetate concentration of corn ensiled in drum silos. Effect of hours of fermentation, P = .02.



Southwest Research-Extension Center

PREFERENCES OF TWO COMMON PARASITES FOR HOST PUPAE AND HABITATS

by
Yu-Jie Guo and Gerald L. Greene

SUMMARY

The predominance of *Spalangia nigroaenea* over *Muscidifurax zaraptor* parasitizing stable fly pupae in Kansas feedlots was explained with laboratory tests. *Spalangia nigroaenea* attacks fly pupae at earlier ages and at lower depths in the medium than *M. zaraptor*. Stable fly pupae occur at about 2 cm in the medium, whereas house fly pupae occur nearer to the surface and are more often parasitized by *M. zaraptor*. Younger pupae are attacked by *S. nigroaenea*, and older pupae are preferred by *M. zaraptor*.

INTRODUCTION

Parasites attacking the stable fly, *Stomoxys calcitrans* (L.), in western Kansas cattle feedlots are predominantly *Spalangia nigroaenea* (Pteromalidae). In spite of this knowledge, most commercial producers release *Muscidifurax* spp for stable fly control, because they are much easier to mass-produce. In the laboratory, *Muscidifurax* clearly shows superior capacity to attack its host and also has a higher stinging rate and shorter development time. Yet in the feedlot environment, it is not effective on the stable fly.

The objective of this study was to explain why *S. nigroaenea* is more common than *Muscidifurax* spp in stable fly pupae in cattle feedlots and what is the mechanism regulating the competition between *S. nigroaenea* and *M. zaraptor* under rearing conditions.

PROCEDURES

Host Preference for Pupa Age. Based on our observation that both *S. nigroaenea* and *M. zaraptor* develop well on house fly pupae in laboratory conditions, the present experiments were conducted using house fly (*Musca domestica* L.) pupae as the host.

Using a free-choice test, host pupae at ages of 0-1, 1-2, 2-3, 3-4, 4-5, and 5-6 days were exposed separately to one parasite species for 24 hrs of stinging. Each host age was replicated three times. The parasites emerging from stung pupae were counted after 4 weeks in the laboratory.

Habitat Preference. The fly pupae were placed in containers with no medium (0 cm) or at 2, 4, and 6 cm depths in medium. Pupae were exposed to the parasite for 24 hrs. The numbers of parasites at the 4 depths were counted when containers were removed from the stinging cage.

Secondary Parasitization. The test was conducted to evaluate whether early-parasitized fly pupae are attacked later by another parasite species. Twenty-four-hr-old house fly pupae were provided for parasitization by the first parasite species for 24 hrs. At 72 hrs, the parasitized pupae then were exposed to the other parasite species for stinging for 24 hrs. The survival rates of the parasites within host pupae were examined 4 weeks later.

RESULTS AND DISCUSSION

Host Preference for Pupa Age. Results showed that *S. nigroaenea* significantly prefers 0- to 1-day-old pupae for oviposition. However, *M. zaraptor* commonly laid eggs on 2- to 5-day-old or even older pupae, but very few on 0- to 2-day-old pupae (Figure 1). These preferences provide a time sequence for these two parasites to attack the fly pupae with little competition and also give *M. zaraptor* a potential opportunity to capture *S. nigroaenea* in host pupae parasitized earlier.

On the other hand, both *S. nigroaenea* and *M. zaraptor* mostly fed on 0- to 2-day-old pupae and induced a large portion of the mortality by feeding activity, so-called parasite-induced mortality (Figure

Fig. 1. Preference of the two adult parasites for host pupa age.

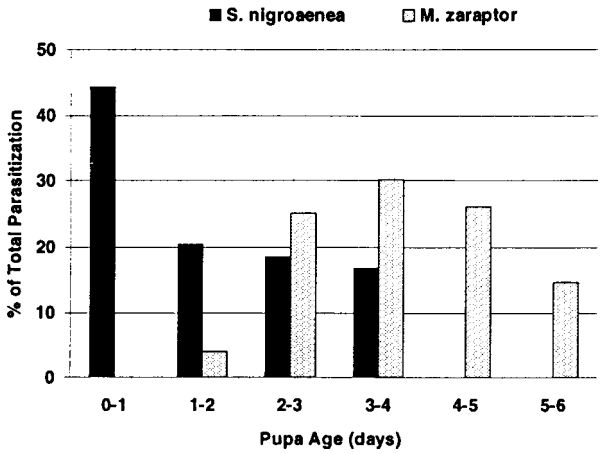


Fig. 2. Effect of host pupa age on parasite feeding activity, expressed as parasite-induced mortality.

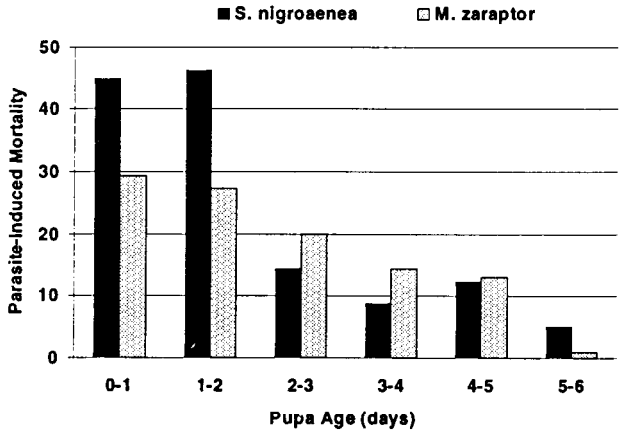
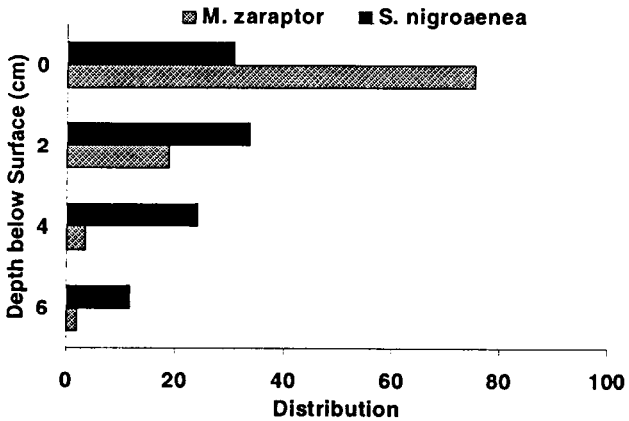


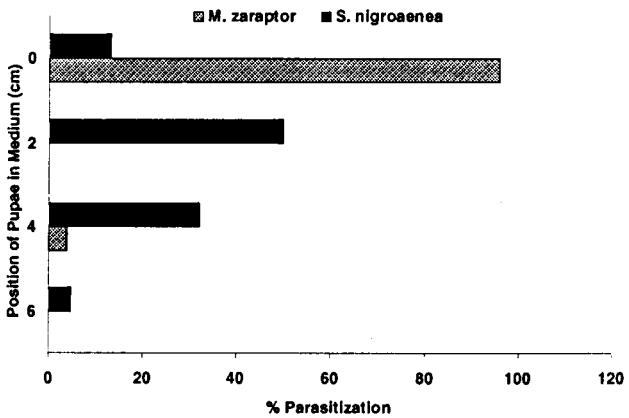
Fig. 3. Habitat preference of the two adult parasites.



activity, so-called parasite-induced mortality (Figure 2). This feeding preference was higher for S. ***nigroaenea*** than ***M. zaraptor.***

Habitat Preference. As shown in Figure 3, the searching activity of S. ***nigroaenea*** adults was 0 - 6 cm deep for host fly pupae, with a tendency to prefer pupae closer to the surface, and the highest parasitization rate was achieved in the 2 to 4 cm depth for S. ***nigroaenea*** (Figure 4). Most of the M. ***zaraptor*** stayed on or near the surface of the medium to search out host pupae (Figure 3), and the highest parasitization occurred in the naked pupae (no medium, Figure 4). This behavior difference between the two parasites may be one of the major mechanisms to avoid competition in natural conditions. Stable fly larvae prefer a relatively high-moisture medium to pupate, which normally occurs in a deeper habitat. This may explain partially why S. ***nigroaenea*** is more abundant in stable flies and ***M. zaraptor*** in house flies in feedlot samples.

Fig. 4. Effect of pupating position in medium on parasitization.



Secondary Parasitization. Because of the low stinging rate by S. ***nigroaenea,*** statistic analysis was not carried out. However, a general trend did provide some cues for further investigation. Once a pupa was parasitized by ***M. zaraptor,*** it was never attacked secondarily by ***S. nigroaenea.*** In contrast, several times, the pupae first parasitized by ***S. nigroaenea*** were being fed on by ***M. zaraptor,*** so that the ***S. nigroaenea*** was killed eventually even at the late larval or early pupal development stage.

Southwest Research-Extension Center

SEASONAL OCCURRENCE OF STABLE FLIES IN SOUTHWEST KANSAS IN 1997

by
Gerald L. Greene and Yu-Jie Guo

SUMMARY

Seasonal occurrence of adult stable flies in cattle feedlots in southwest Kansas was monitored continuously in 1997. Weekly trap counts of adult stable flies peaked in early July, about 2 weeks earlier than the 15-year average (1982-1996). A secondary peak occurred in late August and early September. The above-average rainfall from May to August produced a seasonal population pattern that differed from the 15-year average.

INTRODUCTION

Stable flies, *Stomoxys calcitrans* (L.), have caused long-term problems for beef production in confined cattle feedlots in southwest Kansas. To develop an effective management strategy, a better understanding of population development is needed. Accurate prediction of seasonal occurrence relative to biological and physical environmental conditions will aid in timely fly control. The annual seasonal sampling of stable flies has been conducted since 1982.

PROCEDURES

In 1997, the weekly sampling started in the first week of May. As in previous years, four cylindrical, translucent, Alsynite traps covered with adhesive sleeves were placed in each feedlot. The traps were checked weekly, and the adhesive sleeves changed. A total of 19 feedlots was sampled during 1997. The weather record was obtained from the US Weather Bureau at the Southwest Research-Extension Center.

RESULTS AND DISCUSSION

The occurrence of adult stable flies in 1997 was earlier, with the major peak in early July followed by a minor peak in late August and early September (Figure 1). The abundance was relatively higher, with more than 200 flies/trap/week occurring in 6 weeks between May and July and 5 weeks between August and September. The major peak from June 29 - July 5 had 592.6 ± 65.1 adult stable flies per trap, and the minor peak from August 30- September 5 had 341.9 ± 37.6 flies.

The peak population in 1997 was about 2 weeks earlier compared to the 15-year average for seasonal population dynamics of adult stable flies in southwest Kansas. The additional secondary peak in September differed from the 15-year average (Figure 2). The difference in the fly occurrence from previous year's samplings was associated with the unusual weather conditions, especially the rainfall (Figure 3). In May and June, 4.49 in. and 5.55 in. rain were received, which were 1.42 in. and 2.06 in. higher than the 1982 to 1996 averages. Rainfall in July was about 1 in., which was 1.6 in. lower than average. This rainfall pattern resulted in the earlier major population peak and population decline in July. The August precipitation was well above average (6.93 in. compared to 2.28 in.), which made this summer relatively cool and lead to a secondary peak of adult stable flies in early September. The average monthly high temperatures in May and July of 1997 were similar to the 15-year average, but averages in June and August were lower (83.1 vs 85.3°F and 86.8 vs 89.1°F) (Figure 4). The total monthly rainfall showed a significant difference between 1997 and the 15-year average.

Considerable differences occurred among feedlot fly populations. Feedlots with low rainfall had lower fly populations and vice versa. The average number of stable flies per trap ranged from 47 to 776 in one week and 80 to 803 in another week. Rain and feedlot sanitation drastically affect stable fly numbers, with clean dry feedlots having much lower fly populations.

Fig. 1. Seasonal population dynamics of stable flies in southwest Kansas, 1997.

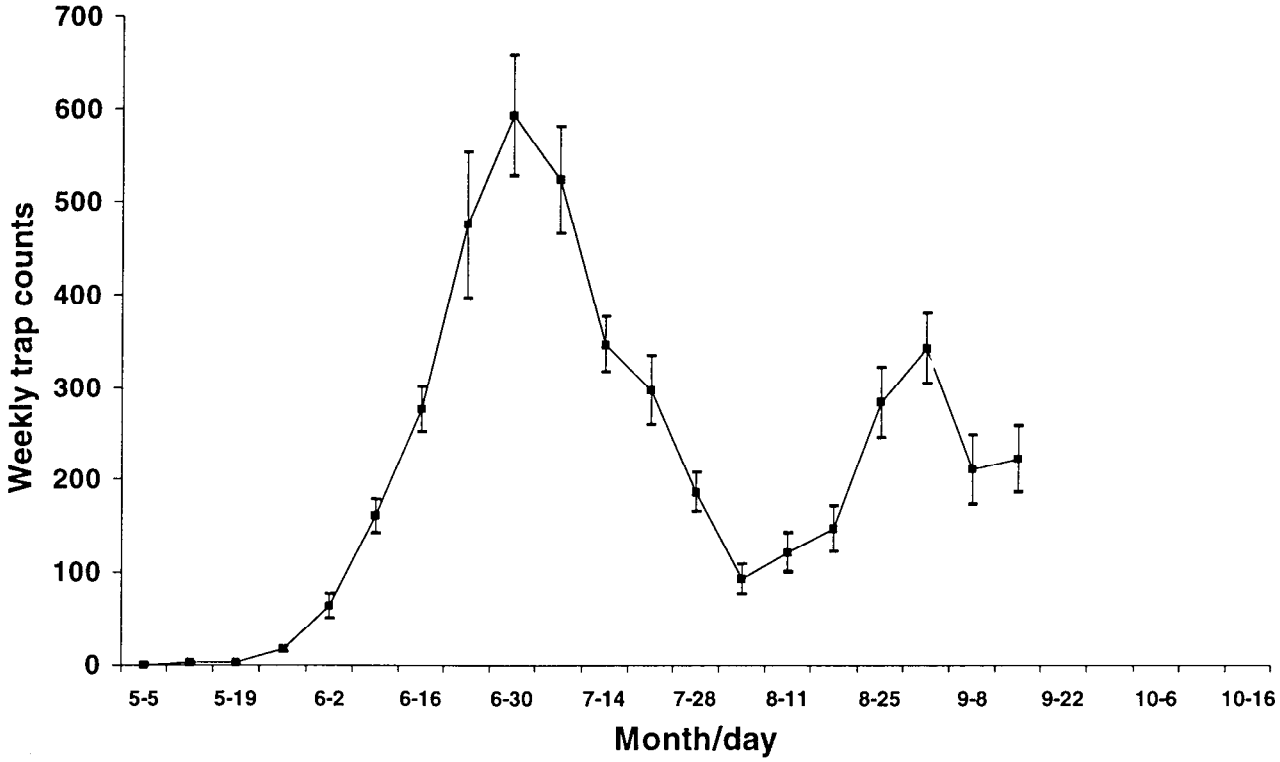


Fig. 2. Seasonal occurrence of stable flies in southwest Kansas: 15-year average (1982-1996) and 1997.

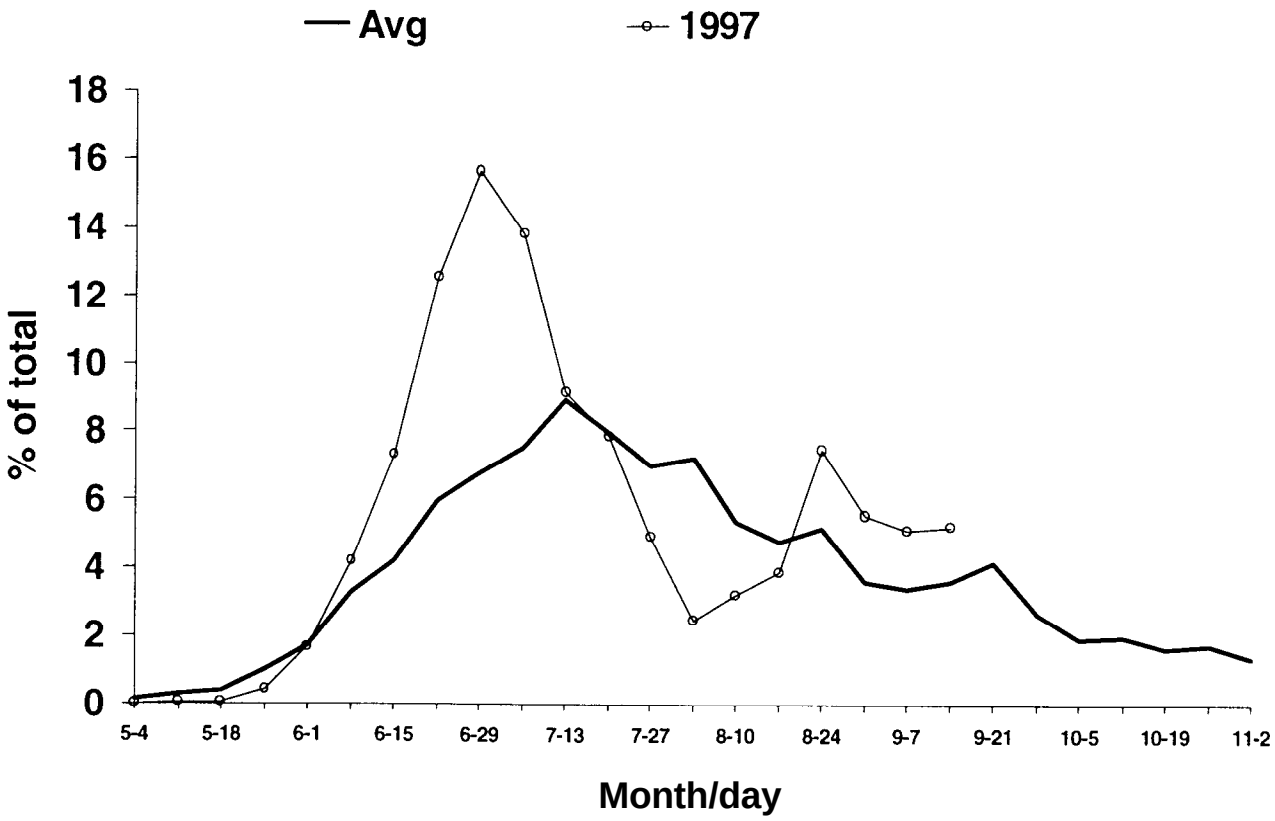


Fig. 3. Monthly precipitation in southwest Kansas: 15-year average (1982-1996) and 1997.

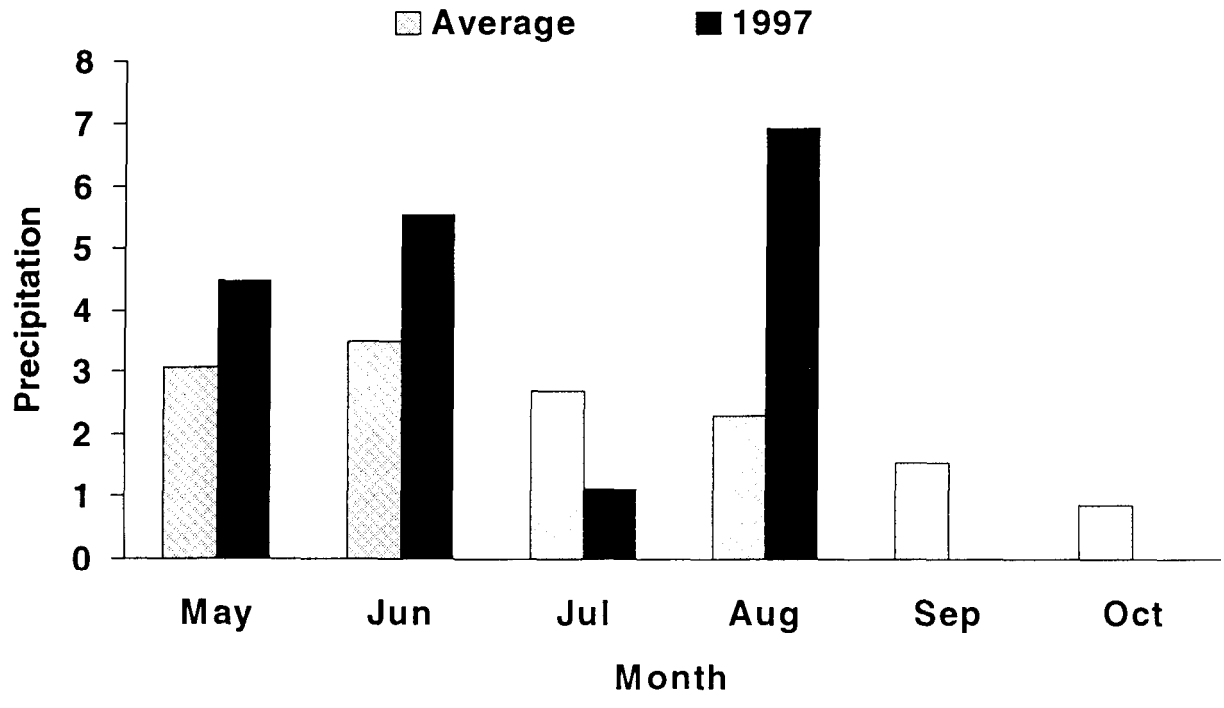
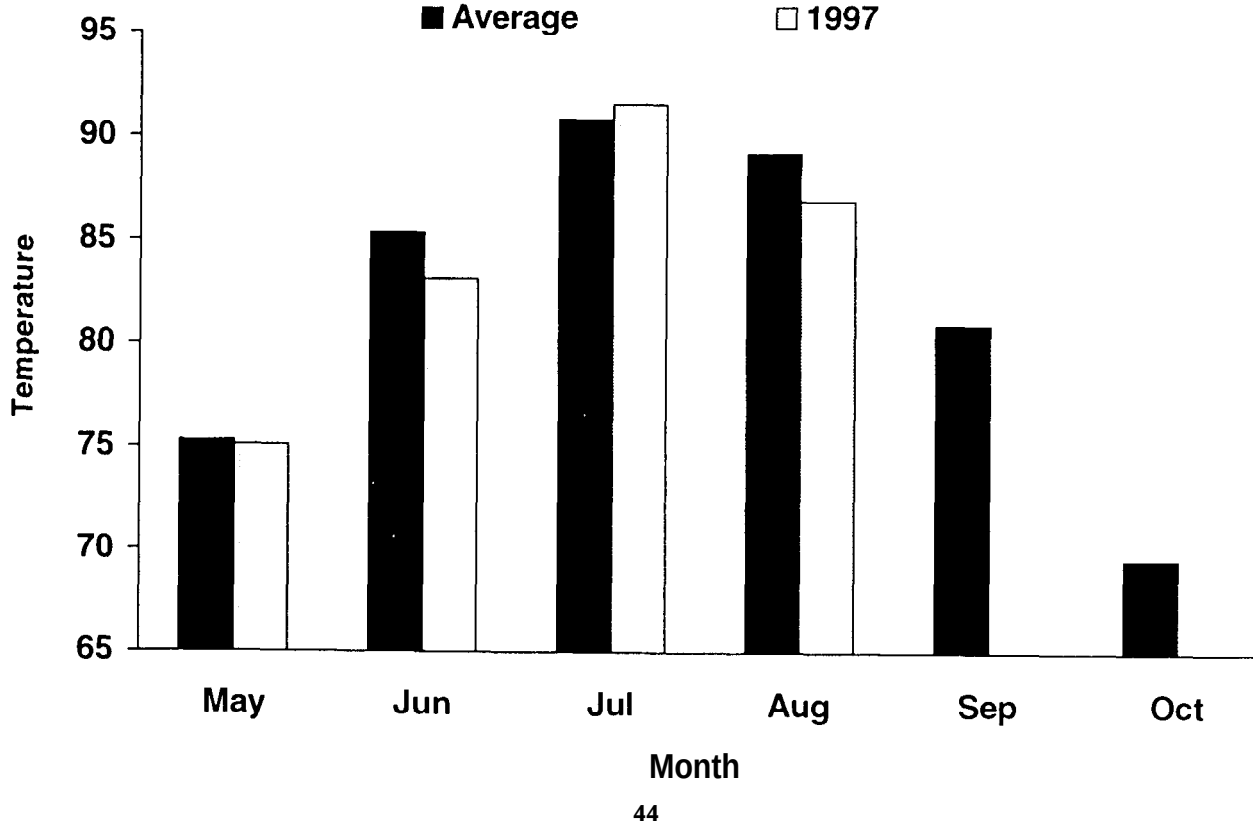


Fig. 4. Monthly high temperatures in southwest Kansas: 15-year average (1982-1996) and 1997.



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Brookover Enterprises, Garden City, KS
Cattlemen's Feedlot, Turon, KS
Pete Clair, Dodge City, KS
Elanco, Indianapolis, IN
5-N Feeders, Inc., Johnson City, KS
Farm Credit of Garden City, PCA/FLBA, Garden City, KS
Farnam Companies, Inc, Phoenix, AZ
Farr Better Feeds - Cargill, Garden City, KS
Feed Mercantile, Inc., Garden City, KS
Fidelity State Bank, Garden City, KS
Floyd Feeders, Johnson, KS
Fort Dodge Animal Health, Overland Park, KS
Bradley Fuller, Lakin, KS
GC Marketing, LC - Garden City, KS
Grant Co. Feeders, Ulysses, KS
Great Plains Chemical, Garden City, KS
Heyco-Oswalt, Garden City, KS
Hitch Feeders II, Garden City, KS
Hoechst-Roussel Agri-Vet Company, Kansas City, MO
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Hubbard Block Division,White Wood, SD
IBP, Holcomb, KS
Ivy Labs, Overland Park, KS
Kansas Sorghum Commission, Topeka, KS
Kansas Soybean Commission, Topeka, KS
Kearny County Feeders, Inc, Lakin, KS
Lane Co. Feeders, Inc., Dighton
Lynch Feedyard, Inc., Dodge City, KS
Mallinckrodt Veterinary, Inc., Medicine Lodge, KS
Meadowlark Angus, Copeland, KS
Merck Agvet Division, St. Louis, MO
Mid-America Millwright, Garden City, KS
Miles, Inc., Shawnee Mission, KS
No Bull Enterprises, LLC, St. Francis, KS
Northern Sun, Goodland, KS
Perrier Feed Yard, Dodge City, KS
Pfizer Agricultural Division, Lee’s Summit, MO
Price Cattle Company, Garden City, KS
Royal Beef Inc., Scott City, KS
S-Bar Ranch Feedlot, Sublette, KS
Reeve Cattle Co., Inc., Garden City, KS
Rex Stanley Feed Yard, Inc., Dodge City, KS
Rhone Merieux, Inc., Garden City, KS
Scott Pro, Inc., Garden City, KS
Servi-Tech Laboratories, Dodge City, KS
Sublette Feeders, Sublette, KS
Syntex Animal Health, Des Moines, IA
The Garden City Coop, Inc., Garden City, KS
Vet Life, Inc., Overland Park, KS
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