1991
CATTLE FEEDERS' DAY

Report of Progress 632

Agricultural Experiment Station Kansas State University, Manhattan
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KANSAS STATE UNIVERSITY
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Garden City

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General Procedures for Feeding Trials

Unless otherwise specified in individual articles, the following represent standard operating procedures for experiments reported herein.

Animal Receiving and Processing:

Cattle were individually weighed and ear-tagged immediately upon arrival or at processing. Processing, which occurred 24 to 48 hours later, consisted of implanting and treatment for endo- and ectoparasites with a de-wormer drench or injectable and pour-on insecticide, respectively. Animals were vaccinated against IBR, BVD, PI_3 (modified-live vaccine), and BRSV in combination with five strains of Leptospira and(or) Haemophilus somnus and injected with a 7-way clostridial bacterin. Horns were tipped and(or) removed to poll and castrations were performed as needed. Animals were implanted per protocol procedures.

Animal Weights and Slaughter:

Initial weights, except where specifically stated, were off-truck weights adjusted to pay weights. Interim weights to monitor trail progress were single-day, individual, early morning, 'full live' weights taken approximately every 28 days. Final full live weights were obtained on 2 consecutive days. Animals were generally shipped and slaughtered on the same morning that the second final full live weight was taken. Liver abscess and hide pull scores were taken at slaughter. Carcass data were obtained following a 24-hour chill.

Animal Feeding:

All cattle were fed once daily from a truck-mounted mixer-feeder equipped with programmable scales and printers. Steam-flaked grains and rolled grains were processed through an 18 X 24 inch Ross roller mill. Intended flaking densities for milo, corn, and wheat were 26, 28, 39 lb/bu, respectively. Micro-ingredients were added to the daily ration at mixing by way of a computer-operated, automatic flushing, weigh machine.

PERFORMANCE OF FEEDLOT STEERS FED HIGH ENERGY DIETS CONTAINING LAIDLOMYCIN PROPIONATE WITH AND WITHOUT ANTIBIOTICS

by

A.S. Freeman, H.R. Spires, and R.L. Botts

SUMMARY

A 134-day finishing trial with 200 steers (792 lbs avg body wt) was conducted to determine effects of laidlomycin propionate or monensin fed with or without bacitracin methylene disalicylate (BMD) or tylosin (T) in a steam-flaked corn diet on performance, carcass characteristics, and liver abscesses. Treatments were: control (C), no ionophore or antibiotic; monensin (M), 30g; monensin plus tylosin (MT), 30g + 10g; laidlomycin (LP), 10g; and laidlomycin plus BMD (LPBMD), 10g + 8g (per ton 90% dry matter basis). Dry matter intake (DMI) for the first 28 d was increased (P<.10) 9.2% for LP and LPBMD compared to MT, but was not different (P>.10) from C. For the first 28 d, LP steers' DMI was 6.5% greater (P<.10) compared to M. Cumulative DMI for LP was increased (P<.10) 7.25% compared to M and MT, but was not different (P>.10) from C and LPBMD. Cumulative average daily gain (ADG; avg of 3.24lbs) was not affected (P>.10) by treatment; however, ADG for LP was increased 4% over C and 6.8% compared to M, MT and LPBMD. Feed efficiency (F/G; avg of 5.48) was not affected (P>.10) by treatment. MT steers' cumulative F/G was slightly improved (1%) compared to C, M, and LP and was improved 2% over LPBMD. Hot carcass weight was increased (P<.10) by LP but was decreased by M, MT, and LPBMD compared to C steers. Other carcass characteristics were not affected by treatments. Abscessed livers were: C 33%, M 38%, MT 8%, LP 26%, and LPBMD 15%. LP improved overall feedlot performance and did not affect carcass characteristics. Addition of tylosin or BMD reduced liver abscesses.

INTRODUCTION

Ruminant nutritionist strive to improve the efficiency of feed conversion into body weight gains by means of manipulating ruminial fermentation patterns and the digestive physiology of the host ruminant. In the past decade, several ionophores (carboxylic polyethers) such as monensin have been used by the beef cattle industry to increase feed efficiency. With the introduction of new ionophores, the producer will potentially be able to increase his management choices.

Laidlomycin propionate is one such new ionophore receiving greater attention. This ionophore has not received FDA approval, but performance in feedlot cattle fed laidlomycin has been comparable to those receiving lasalocid.

Previous research has shown ionophores to enhance efficiency of beef cattle in grazing situations and in the feedlot. It is generally thought that ionophores increase feed efficiency of cattle by altering ruminal fermentation by selecting against gram positive and hydrogen- and formate-producing bacteria.

Ionophores are effective in enhancing energy retention and protein utilization and reducing metabolic disorders (e.g., bloat and lactic acidosis) in cattle. Increased energy retention has been related to increased ruminal proportions of propionic acid and a subsequent decrease in acetic and butyric acids. A further enhancement of energy retention has been related to lower methane production, which may be associated with shifts in volatile fatty acid proportions, thus allowing for retention of additional energy by the host animal as tissue gains.

The object of the study was to obtain information on the comparative efficacy of laidlomycin propionate, monensin, laidlomycin propionate plus bacitracin methylene disalicylate (BMD), and monensin plus tylosin for increasing the rate of weight gain and improving feed efficiency in cattle fed high energy diets.

EXPERIMENTAL PROCEDURES

Cattle were purchased through an order-buyer from two ranches located in Northwest Kansas between Plainville and Hays. Both herds included calves of Angus-Hereford dams crossed with Simmental sires. The long yearling steers were weaned from late November to early December, 1988. Cattle were of uniform size, genetic bloodlines, and nutritional management, which consisted of backgrounding on a chopped cane and feed-corn silage mixture (silage was 20% of roughage portion), 1 pound of a 41% crude protein cottonseed meal range cube per head per day, and 1 pound ground milo per hundred weight per head daily.

The first group of steers (150) arrived at the SWKREC on March 6 and the second group (60) on March 7, 1989, giving a total of 210 steers. Cattle were visually appraised upon arrival for any signs of sickness, lameness, etc., and such animals were isolated in sick-pens at that time. Cattle were allowed free-choice access to long-stem bromegrass hay, fresh water, and a starter diet (Table 1) and processed on March 9, 1989.

Table 1. Composition and nutrient analysis of starter and step-up diets on a dry matter basis.

Item	Starter	Step-up
Ingredients	%	%
Corn, Dry-Rolled	42.2	
Corn, Steam-Flaked		63.4
Alfalfa Hay	51.9	27.9
Blended Molasses	3.7	3.0
Yellow Grease		2.3
Pelletted Supplement	2.2	3.4
Bromegrass Hay-Baled[a]	Free Choice	
Nutrient Analysis[b]		
Dry Matter	86.63	84.02
Crude Protein	14.10	12.56
Calcium	.95	.76
Phosphorus	.27	.32
Potassium	1.19	.89
TDN[c]	69.2	82.5
NEm, Mcal/100 lb	77.9	95.7
NEg, Mcal/100 lb	46.0	62.5

[a] Baled hay removed on March 10, 1989.
[b] Nutrient analysis based on NRC tabular values.
[c] Percent total digestible nutrients.

All steers were individually weighed and processed per standard procedures. Individual steer weights ranged between 645 lbs to 887 lbs, with an average weight of 761 lbs.

Step-up Period: All steers received a common starter diet with bromegrass hay free choice (Table 1) for a period of 5 days. The ration and baled hay were delivered once daily in the morning to each feed bunk. Amounts fed each day were sufficient to provide *ad libitum* consumption without accumulation of unconsumed feed. The bromegrass hay was withdrawn after a 5-day period, and the starter diet was fed for an additional 5 days.

Cattle were then fed a step-up ration 2 (Table 2) once daily in the morning. Microingredients were supplied in the diets, through a micro-weigh system machine. Deccox® (decoquinate) was supplied at a rate of 20.73 mg/cwt of body weight to prevent coccidosis. The coccidostat was removed after a 24-day step-up period.

After the step-up period, all steers were individually weighed, and Tiguvon® was applied per product instructions as a grubicide. Steers were culled to 200 head and blocked by weight into four groups: 1) light, 2) light-medium, 3) medium, and 4) heavy. Weight blocks were randomly assigned to five consecutive pen groups with treatments randomly assigned to each pen within each weight block-pen group. Steers were then randomly assigned to treatments within each weight block.

The following day, all steers were re-weighed, implanted with Synovex-S®, and sorted by treatment-weight block into respective pens. The final finisher diet (Table 2) was then offered. Ionophores and antibiotics were supplied in the finisher diet via the micro-weigh machine.

Table 2. Composition and nutrient analysis of finsisher diets on a dry matter basis.

Item	Step-up 2	Final
Ingredients	%	%
Corn, Steam-Flaked	84.3	82.6
Alfalfa Hay	6.5	6.5
Blended Molasses	2.3	2.3
Yellow Grease	1.8	3.5
Cottonseed Meal	1.1	1.1
Pelletted Supplement	4.0	4.0
Nutrient Analysis[a]		
Dry Matter	77.6	77.6
Crude Protein	11.7	11.8
Calcium	.40	.42
Phosphorus	.30	.29
Potassium	.74	.72
TDN[b]	87.5	87.5
NEm, Mcal/100lb	102.0	102.5
NEg, Mcal/100lb	70.0	69.5

[a] Nutrient analysis determined on complete feed ration after micromachine ingredient delivery.
[b] Percent total digestible nutrients.

Final treatments were as follows: 1) CON, control, no ionophore and no antibiotic; 2) MON, monensin ®, 30 g/ton (90% dry matter basis); 3) M/T, MON at 30g/ton and 10 g/ton of tylosin sodium (Tylan 100)® to provide approximately 90 mg Tylan per head per day; 4) LP, laidlomycin propionate, 10 g/ton; and 5) LP/BMD, LP at 10g/ton plus 8g/ton of bacitracin methylene disalicylate (BMD)® to supply approximately 70 mg BMD per head daily. Both ionophores and antibiotics in the complete finisher diet batches were fed simultaneously and continuously each morning throughout the finishing period. Feed batches were mixed and delivered to bunks by a mixer-feeder box mounted on a truck. A complete batch mix was determined by a truck timer electronically connected to the PTO unit driving the mixer-box augers. Mixing time per batch load was constant throughout the trial.

A step-up period for monensin occured during the first weigh period. Monensin was fed at 15 g/ton (90% DMB) for a 7-day adjustment period. Then monensin was increased to 30 g/ton (90% DMB) until the end of the trial period.

Feed was provided once daily in amounts sufficient to provide ad libitum consumption. Feed bunks were visually evaluated each morning, and the daily feed offered was adjusted according to amounts eaten the previous day. This provided ad libitum intake without accumulation of unconsumed feed. Only during the first 28 days, feed refusals in each bunk were weighed on the truck scales to the nearest 5 pounds and recorded. Feed samples were collected weekly from the feed truck after complete mixing for dry matter determination and composited for each 28-day weigh period. Samples were subsequently analyzed for various nutrient constituents (Tables 1 and 2).

Cattle were individually weighed at 28-day intervals prior to morning feeding. Daily feed intakes, both period and cumulative, were calculated as total feed provided to a pen minus any discarded feed and (or) plus previous day carrier-over feed divided by the total head days during a weigh period or across total days on feed. Feed-to-gain ratio was calculated for each pen as the ratio of total feed consumed divided by total weight gained per pen during a 28-d weigh period or across total days on feed. Average daily gain was calculated on a pen basis as total weight gain divided by total head days for each period or across total days on trial. Final weights were obtained on 2 consecutive days and averaged.

All cattle were slaughtered when, by visual appraisal, an estimated 70% would grade USDA choice. Slaughter data included: 1) incidence of liver abscesses, 2) hot carcass weight (HCW), 3) rib-eye-area (REA), 4) back fat thickness (BF), 5) kidney-pelvic-heart fat percentage (KPH), 6) marbling score (MS), 7) quality grade (QG), and 8) calculated USDA yield grade (YG). Hot carcass weights and liver abscess scores were obtained at slaughter. All other carcass measurements were made after a 24-hour chill.

Period lengths in days were: Period 1 (1-28 days, 28 d); Period 2 (29-56 days, 28 d); Period 3 (57-100 days, 44 d); and Period 4 (101-134 days, 35 d). Experimental design for the study was completely randomized with pens serving as the experimental unit for performance data. Individual animals served as the experimental units for the carcass and liver data analysis. Data were analyzed by analysis of variance procedures utilizing the General Linear Model procedures of SAS Institute. When a significant F-test ($P<.10$) for a particular independent variable (e.g., DMI, ADG, etc.) was detected, a multiple-range test was used to separate means.

Heavy weight block steers were weighed off-trial on days 99 and 100 of the feeding period. Laidlomycin and BMD were withdrawn from the heavy weight block diets at this time. These steers were fed the CON treatment for a period of 14 days. These steers were shipped to slaughter after the 14-day withdrawl period.

Remaining steers were weighed off trial after 134 days on trial. Laidlomycin and BMD were withdrawn from their diets for a period of 14 days. The CON treatment was fed during the 14-day withdrawal period. The remaining 155 head were then slaughtered after the withdrawl period.

RESULTS AND DISCUSSION

Dry Matter Intake: Cumulative DMI across periods is presented in Table 3. A significant ($P < .08$) treatment effect was evident in the first 28 days on feed. The addition of LP and LPBMD did not affect ($P > .10$) DMI compared to CON. However, steers receiving LP and LPBMD consumed 5.5% and 9.3% more feed compared to MON and MT steers, respectively. Intake by MT steers was depressed by 10.2% compared to LP steers.

Table 3. Cumulative dry matter intake of feedlot steers fed high concentrate diets containing either monensin or laidlomycin propionate with or without antibiotics.

Item	Treatments				
	CON	MON	MT	LP	LPBMD
	-lbs-				
Day					
1-28	16.31[c]	15.41[bd]	14.87[b]	16.39[c]	16.06[cd]
1-56	17.36	16.63	16.65	17.75	17.34
1-100[a]	18.20	17.51	17.80	18.51	18.20
1-134[a]	17.83[ef]	17.05[e]	16.97[e]	18.54[f]	17.77[ef]

[a] Day 1-100, n=20.
Day 1-134, n=15. No heavy rep.
[bcd] Row means with uncommand superscripts are different, $P \leq 0.08$.
[ef] Row means with uncommand superscripts are different, $P \leq 0.02$.

During the next 73 days, DMI averaged 17.60 pounds per head per day and was not affected by treatment (P > .10). After 134 days on feed, MON and MT depressed (P < .02) DMI by 9% compared to the intake of LP steers. Intake for the MON and MT steers was also decreased (P > .10) by 4.8% compared to CON steers; a difference of 0.82 pounds dry matter per head per day. Dry matter intake for LP and LPBMD was not different (P > .10) compared to CON. Intake for CON, LPBMD, MON, and MT were similar (P > .10) after 134 days on feed.

Average Daily Gain: Cumulative average daily gain (ADG) by treatment for each weigh period is given in Table 4. An adjustment for fill was not made to determine ADG; therefore, performance was based on 'full' weights. Within period, ADG was not affected (P > .10) by treatment. Averaged across treatments within each period, ADG was 3.51, 4.09, 2.78, and 3.40 pounds for periods 1, 2, 3, and 4, respectively. Cumulative ADG was not affected (P > .10) by treatment for the first 28 days on feed. By 56 days, treatment effects were present (P < .09). ADG of steers receiving MON and MT was depressed by 7.5% and 12.2% compared to CON and LP steers, respectively. LP steers' ADG was improved by 6.8% compared to steers consuming LPBMD. A nonsignificant improvement of 4.4% for the LP steers compared to CON was evident. No difference in ADG was noted for the LPBMD steers compared to the CON, MON, and MT steers. By the end of the trial, cumulative ADG was not different (P > .10) between treatment groups. However, steers consuming the LP diet had a 3.7% advantage over CON and a 6.96% improvement above MON, MT, and LPBMD steers.

Table 4. Cumulative average daily gain of feedlot steers fed high concentrate diets containing either monensin or laidomycin propionate with or without antibiotics.

Item	Treatments				
	CON	MON	MT	LP	LPBMD
	-lbs-				
Day					
1-28	3.77	3.36	3.14	3.73	3.54
1-56	3.89[cd]	3.62[b]	3.62[b]	4.06[d]	3.80[bc]
1-100[a]	3.37	3.29	3.27	3.23	3.35
1-134[a]	3.26	3.12	3.19	3.38	3.18

[a] Day 1-100, n=20.
Day 1-134, n=15. No heavy rep.
[bcd]Row means with uncommand superscripts are different, P ≤ 0.09.

Feed to Gain Ratio: Cumulative feed efficiency (F/G) by treatment is given in Table 5. Because ADG was calculated on a 'full' basis, F/G was also calculated on a 'full' basis. Treatment did not affect (P > .10) feed efficiency throughout the feeding trial. Steers required 5.48 pounds of dry matter for every pound of full weight gain. Steers receiving MT consumed an average of 0.18 pounds less dry matter compared to other steers. However, LPBMD steers consumed an average of 0.16 pounds more feed compared to other animals.

Table 5. Cumulative feed to gain ratio of feedlot steers fed high concentrate diets containing either monensin or laidlomyein propionate with or without antibiotics.

Item	Treatments				
	CON	MON	MT	LP	LPBMD
	-lbs-				
Day					
1-28	4.38	4.59	4.80	4.40	4.56
1-56	4.49	4.60	4.61	4.37	4.56
1-100[a]	5.42	5.32	5.45	5.25	5.43
1-134[a]	5.48	5.48	5.33	5.49	5.60

[a] Day 1-100, n=20.
Day 1-134, n=15.

Carcass and Liver Data: Carcass characteristics and liver abscess data are presented in Table 6. Adjusted final weight for the MON steers was depressed by 3.3% (P < .09) compared to the average adjusted final weight of the CON and LP steers. Adjusted final weights were not different (P > .10) between treatments CON, MT, and LPBMD. Weights for LP and CON steers were also similar (P > .10). However, adjusted final weights of LP steers was 2.2% greater (P < .09) compared to MT and LPBMD steers. Overall, steers receiving LP alone had a 2.35 pound advantage per hundred pounds of body weight compared to steers on other treatments. Hot carcass weight was the only carcass characteristic that was affected (P < .10) by treatment. The LP steers' HCW was 22 pounds more compared to the LPBMD, MON, and MT steers' HCW. MON steers' HCW was depressed by 30 and 21 pounds compared to LP and CON steers, respectively. However, MON steers' HCW was similar to that of MT and LPBMD steers. The CON steers' HCW did not differ from that of LP, MT, and LPBMD groups. Dressing percent averaged 63.6%. An average 13.21 square inch rib-eye, backfat thickness of 0.42 inches and KPH % of 2.01

was measured across treatments. Marbling score averaged 4.99 or just below the Low Choice Quality Grade for all steers on trial. The MON and LPBMD steers fell into the Low Choice Quality Grade. The other treatment groups fell into the Select Quality Grade. Calculated USDA Yield Grade averaged 2.68 for all steers.

Abscessed livers for each treatment were: 50% CON, 50% MON, 26% Mt, 36% LP, and 45% LPBMD. These percentages include livers with abscess scars that were not condemned. Those livers condemned were: 33% CON, 38% MON, 8% MT, 26% LP, and 15% LPBMD. Liver abscess score averaged 1.9 on a scale of 1 to 5; with 1 being no abscesses and 5 being condemned livers with numerous large abscesses. A linear contrast between treatments with and without antibiotics showed a 73% reduction (P = 0.003) in liver abscess score in steers receiving the antibiotics. Tylosin and BMD were equally affective in reducing (P = 0.2216) liver abscesses.

Table 6. Carcass characteristics and liver abscess data of feedlot steers fed high concentrate diets containing either monensin or laidlomycin propionate with or without antibiotics.

	Treatments				
Item	CON	MON	MT	LP	LPBMD
Steer No.	40	40	39	40	40
Initial Wt, lbs	792	791	793	792	791
Adj. Final Wt,lbs	1205[bc]	1172[a]	1193[ab]	1219[c]	1194[ab]
HCW,lbs	781[bc]	760[a]	772[ab]	790[c]	773[ab]
Dressing %	63.8	63.3	63.7	63.7	63.6
REA, in^2	13.49	12.94	13.21	13.31	13.08
Backfat, in	.43	.41	.43	.42	.43
KPH, %	2.04	2.03	2.03	1.89	2.08
Marbling Score	4.93	5.21	4.78	4.93	5.11
Yield Grade	2.62	2.67	2.68	2.68	2.77
Abscessed Livers, %[d]	50	50	26	36	45
	(33)	(38)	(8)	(26)	(15)
Abscess Scores[e]	2.20	2.33	1.39	1.92	1.75

[abc] Row means with uncommand superscripts are different, P ≤ 0.08.
[d] Numbers in ( ) are % of livers abscessed that were condemned.
[e] Linear contrast between with and without antibiotics, P = 0.003.

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EFFECTS OF IONOPHORE SHUTTLE WITH MONENSIN AND LACALOCID PLUS DUAL IMPLANTING WITH COMPUDOSE AND/OR FINAPLIX-S ON FEEDLOT PERFORMANCE

by
A.S. Freeman

SUMMARY

A 147-day feeding trial evaluated the effects of switching from monensin and tylosin to lasalocid plus oxytetracycline and dual implanting with 24 mg of estradiol-17β (Compudose200®) and 140 mg of trenbolone acetate (Finaplix-S®) at day 54 on the feedlot performance, carcass traits, incidence of liver abscesses, and difficulty of hide pulling. Ninety English-continental crossbred beef steers were randomly allotted to five treatments, with three pens of six head each per treatment. The treatments were: 1) CON, control with no ionophore, antibiotic, or implants; 2) MTC, monensin (30g/ton) plus tylosin (9g/ton) with Compudose200 continuously; 3) MTCF, monensin plus tylosin with Compudose200 and dual implanting with Finaplix-S on day 54; 4) MTLC, monensin plus tylosin then switching to lasalocid (30g/ton) plus oxytetracycline (7g/ton) at day 54 with Compudose200 continuously; and 5) MTLCF, monensin plus tylosin then switching to lasalocid plus oxytetracycline (OTC) at day 54 with Compudose200 and dual implanting with Finaplix-S at day 54. The finisher diet was 81.6% high moisture corn, 4.9% ground alfalfa hay, 3.8% corn silage, 1.8% blended molasses, 2.7% yellow grease, and 5.2% pelleted supplement on a dry matter basis. Treatments did not affect (P>.10) cumulative dry matter intake for the 147-day feeding trial. Cumulative average daily gain (CADG) for steers receiving an ionophore plus antibiotic and implant was increased (P<.10) by 11.5% compared with the CON steers. The gains for MTC and MTLCF were not different (P>.10). However, MTLCF increased (P<.10) gains by 6.5% compared with the average gains of MTCF and MTLC steers. There was a 16.6% improvement (P<.10) in gains for MTLCF compared with CON steers. The CON steers required 11% more (P<.05) feed for each pound of live weight gain compared with the other treatments. Average adjusted final weight (1231 lb), hot carcass weight (786 lb), dressing percentage (64.7%), rib-eye area (12.9 in²), lean color (2.9), kidney-pelvic-heart fat percentage (2.4%), marbling score (5.5 or Ch50), liver abscess score (1.4), and difficulty of hiding pulling (1.4) were not affected (P>.10) by treatments. Back fat was increased (P<.04) .14 inches by the ionophores, antibiotics, and implants compared with the CON group. Yield grade was decreased .46 percentage units for MTCF, MTLC, and MTLCF compared with CON and MTC steers (P<.008). Our data suggest no benefit from switching ionophores or dual implanting with either implant at 54 days on feed. However, ionophores and implants did improve feedlot performance and carcass traits compared to control steers.

INTRODUCTION

Ionophores and implants have been used in every facet of the beef cattle industry for improving performance. Feed conversion is typically improved with ionophores by increased average daily and decreased intake, improved gains with no effect on intake, or both increased gain and intake. Implants also enhance performance. Implanted feedlot cattle show 5 to 15% increases in average daily gain and a 5 to 10% improvement in feed efficiency compared with control animals.

Ionophore rotational programs have provided an additional 2 to 4% increase in feed efficiency over continuous feeding. Dual implanting with estrogenic and androgenic implants has also improved performance above single implant programs. Therefore, this trial was conducted to evaluate the effects of switching from monensin plus tylosin to lasalocid plus oxytetracycline and dual implanting with 24 mg of estradiol-17B (Compudose200®) and 140 mg of trenbolone acetate (TBA; Finaplix-S®) at day 54 on the feedlot performance, carcass traits, incidence of liver abscesses, and difficulty of hide pulling in finishing beef steers.

EXPERIMENTAL PROCEDURES

Ninety English-continental crossbred beef steers were received in late November of 1989. These steers were individually weighed off truck and given access to fresh water, bromegrass hay, and a starter diet. The starter diet consisted of 50% ground alfalfa hay, 43% dry rolled corn, 5% blended molasses, and 2% pelleted supplement on an as-fed basis. Deccox® (decoquinate) was fed at 22.7 mg per head daily in the starter, and step-up rations were fed for 22 days then withdrawn. Cattle receiving monensin were fed one half the final amount per head daily for a 2-week period after the decoquinate. Then the monensin was increased to 30 g per ton of feed (90% dry basis).

All steers were weighed again the next day and processed according to standard procedures. The steers were blocked into three weight groups and randomly allotted to five treatments, with three pens of six head each per treatment. The treatments were: 1) CON, control with no ionophore, antibiotic, or implants; 2) MTC, monensin (30g/ton) plus tylosin (9g/ton) with Compudose200 continuously; 3) MTCF, monensin plus tylosin with Compudose200 and dual implanting with Finaplix-S on day 54; 4) MTLC, monensin plus tylosin then switching to lasalocid (30g/ton) plus oxytetracycline (7g/ton) at day 54 with Compudose200 continuously; and 5) MTLCF, monensin plus tylosin then switching to lasalocid plus oxytetracycline (OTC) at day 54 with Compudose200 and dual implanting with Finaplix-S at day 54. The finisher diet was 81.6% high moisture corn, 4.9% ground alfalfa hay, 3.8% corn silage, 1.8% blended molasses, 2.7% yellow grease, and 5.2% pelleted supplement on a dry matter basis (Table 1).

Cattle were fed once daily to allow only for ad libitum consumption without excessive feed accumulation. Feedlot performance was monitored throughout the trial by periodic individual steer weights, measuring pen feed intake, and calculating feed conversion. Hide pulling score was rated at time of slaughter using the scale: hide pull 1 = no resistance, 2 = slight hesitation, 3 = greater hesitation, and 4 = removed by hand. Liver abscess score was taken at time of slaughter to determine incidence of liver abscesses. The scale used was: 1 = no abscesses, 2 = signs of scaring - not condemned, 3 = one to three small active abscesses - condemned, 4 = three to five large active abscesses - condemned, and 5 = more than five or one large active abscess - condemned. Carcass characteristics were measured after a 24-hour chill. Lean color was determined by visual appraisal with the following scale: 1 = light red, 2 = red, 3 = cherry red, 4 = dark red or brown. All feedlot performance data were statistically analyzed by using pen as the experimental unit or replication. Carcass traits, liver abscesses, and difficulty of hide pulling were analyzed using individual steer as the treatment replication.

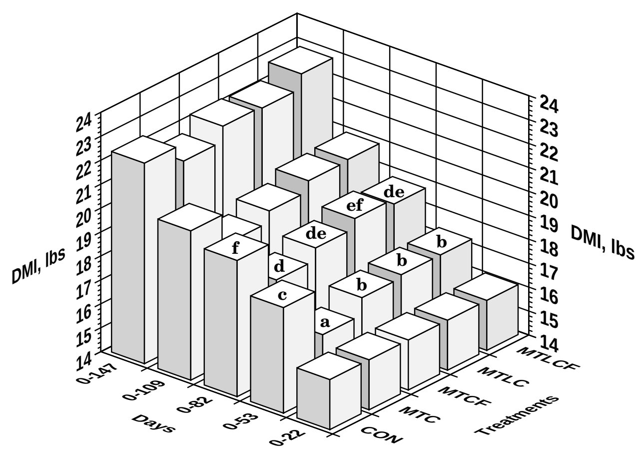
Table 1. Ingredient composition and nutrient analysis of finisher diet on a dry matter basis.

Item	Percent of Dry Matter, %
Ingredients	
High-Moisture Corn	81.6
Alfalfa Hay, Ground	4.9
Corn Silage	3.8
Molasses	1.8
Yellow Grease	2.7
Pelleted Supplement	5.2
Nutrient Analysis	
Dry Matter,	72.3
Crude Protein	11.5
Fiber, NDF and ADF	4.9
NEm, Mcal/cwt	105
NEg, Mcal/cwt	72
Calcium	.61
Phosphorus	.27
Potassium	.75
NaCl	.21

RESULTS AND DISCUSSION

Dry Matter Intake. Cumulative dry matter intake (CDMI) is given in Figure 1 by days on feed. From day 0 to 53, all steers except CON were receiving monensin plus tylosin and were implanted with Compudose. Cumulative DMI was depressed by the addition of monensin (P<.02). Compared with

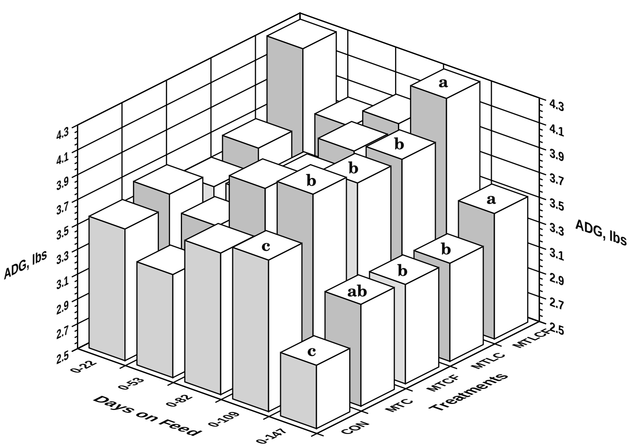
Figure 1. Cumulative dry matter intake by days on feed. Means with different letters differ (a,b,c P<.02; def P<.09).



CON, intake was depressed by 11% for the MTC steers. The MTCF, MTLC, and MTLCF steers consumed 6% and 5% less feed compared with CON and MTC steers, respectively. By day 82 on feed, cattle switched from monensin plus tylosin to lasalocid plus OTC (MTLC and MTLCF) had increased intakes. Intake of MTLC steers at this time was not different from that of CON steers, but was increased (P<.09) by 5% compared with MTC steers. Dual implanting with Finaplix-S did increase intake by .6 lb per head daily when compared with continuous Compudose (MTCF + MTLCF vs MTC). After 147 days on feed, treatments did not affect (P>.10) CDMI (avg of 22.3 lb). Compared with CON, the MTC steers did reduce intake by 3.3% or .74 lb per head daily. Dual implanting increased intake by .7 lb per head daily compared without both implants across ionophore switching. Typically, monensin does decrease intake and lasalocid does increase intake. However, dual implanting with estradiol-17β and TBA implants did not boost intake.

Average Daily Gain. Cumulative average daily gain (CADG) is given in Figure 2. Treatments did not affect (P>.10) CADG until cattle had been on feed for 109 days. Steers on MTC, MTCF, and MTLC gained 7.9% more live weight (P<.10) compared with CON steers. Switching ionophores and dual implanting (MTLCF) further increased (P<.10) gains by 15.6% over CON gain. A 7.2% increase (P<.10) in CADG by 109 days on feed was seen for MTLCF steers compared with gains for MTC, MTCF, and MTLC steers.

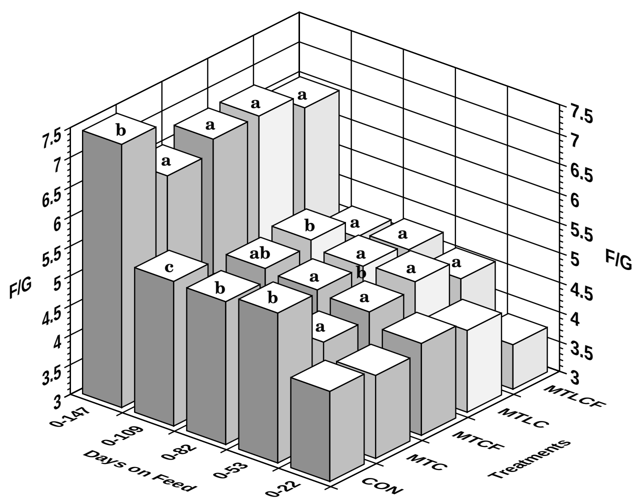
Figure 2. Cumulative average daily gain by days on feed. Means with different letters differ (a,b,c, P<.10).



By 147 days on feed, switching ionophores and dual implanting (MTLCF) did not affect (P>.10) gains compared with MTC. However, MTLCF and MTC increased (P<.10) CADG by 13.5% compared with CON steers' gain. Gains for MTC, MTCF, and MTLC were not different but were increased (P<.10) by 9.8% compared with CON steers' gains. Switching ionophores and dual implanting (MTLCF) improved gains by 6.4% compared with only switching ionophores (MTLC) and just dual implanting (MTCF). It appears that an improvement in gain can be realized by switching from monensin to lasalocid and dual implanting with Compudose and Finaplix-S at 54 days on feed compared with either option alone. However, only an additional .19 lb in ADG resulted from switching the ionophores and dual implanting compared with feeding monensin plus tylosin continuously and only implanting with Compudose.

Feed Conversion. Feed conversion (F/G) by days on feed is given in Figure 3. Feeding an ionophore plus antibiotic and implanting improved F/G compared with the CON group after 53 days on feed. By the end of the feed trial, CON steers required 11% more feed per pound of live weight gain (P<.05) compared with other treatment groups. Essentially, there was no difference in F/G for the MTC and MTLCF steers, but they required .24 lb less feed per unit of gain compared with the MTCF and MTLC steers.

Figure 3. Feed conversion by days on feed. Means with different letters differ (a,b,c, P<.10).



Carcass Traits, Liver Abscesses, and Hide Pull. Carcass traits, liver abscesses, and difficulty of pulling the hide are given in Table 2. Average adjusted final weight (1231 lb), hot carcass weight (786 lb), dressing percentage (64.7%), rib-eye area (12.9 in^2), lean color (2.9), kidney-pelvic-heart fat percentage (2.4%), marbling score (5.5 or Ch^{50}), liver abscess score (1.4), and difficulty of hiding pulling (1.4) were not affected (P>.10) by treatments. Final weights were adjusted on a command basis by dividing HCW by an average dressing percent of 64.7% to eliminate any fill differences between steers. Back fat was increased (P<.04) .14 inches by the ionophores, antibiotics, and implants compared with the CON group but was not different among others. Yield grade was decreased .48 percentage units for MTCF, MTLC, and MTLCF compared with CON and MTC (P<.008). Differences in retail cut-out or cutability were comparable with treatment effects seen for YG. Incidence of liver abscesses and difficulty of pulling the hide were not affected (P>.10) by treatments. Some research trials have shown an increase in 'dark cutters' and difficulty of pulling the hide from the carcass and a decrease in quality grade of steers receiving Finaplix (TBA) implants at various stages throughout the finishing period. This was not the case in this study. Our data suggest no benefit from switching ionophores or dual implanting with either implant at 54 days on feed. However, ionophores and implants did improve feedlot performance and carcass traits compared to control steers.

Table 2. Carcass characteristics, liver abscess score, and difficulty of hide pulling.

	Treatments				
Item	CON	MTC	MTCF	MTLC	MTLCF
No. of Steers	18	18	18	18	18
Initial Wt., lb	783	774	774	776	777
Adj. Final Wt., lb[a]	1200	1234	1223	1240	1259
Hot Carcass Wt., lb	766	788	782	788	805
Dressing Percent, %	65	64.4	64.5	65	64.7
Rib-Eye Area, in^2	13.2	13.3	12.5	12.6	13.0
Lean Color[b]	2.8	2.8	3.1	2.7	2.9
Back Fat, in.	.40[f]	.52[g]	.52[g]	.56[g]	.55[g]
Kidney-Pelvic-Heart Fat, %	2.3	2.4	2.4	2.5	2.5
Marbling Score[c]	5.3	5.7	5.5	5.5	5.5
Quality Grade	Ch^{30}	Ch^{70}	Ch^{50}	Ch^{50}	Ch^{50}
Yield Grade	2.7[j]	3.0[ij]	3.3[hi]	3.4[h]	3.3[hi]
Retail Cut-out, %	50.6[m]	49.8[lm]	49.2[kl]	48.9[k]	49.2[kl]
Liver Abscess Score[d]	1.4	1.6	1.4	1.3	1.2
Hide Pull Score[e]	1.3	1.3	1.3	1.3	1.7

[a] Adjusted Final Weight = Hot Carcass Wt/.647.

[b] 1 = light red, 2 = red, 3 = cherry red, 4 = dark red or brown.

[c] Marbling Score 4.0 - 4.9 = Select (slight marbling); 5.0 - 5.9 =Choice (small to moderate marbling).

[d] 1 = no abscesses, 2 = signs of scaring - not condemned, 3 = one to three small active abscesses - condemned, 4 = three to five large active abscesses - condemned, and 5 = more than five or one large active abscess - condemned.

[e] Hide Pull 1 = no resistance, 2 = slight hesitation, 3 = greater hesitation and 4 = removed by hand.

[fg] Means with different superscripts differ, P<.04.

[hij] Means with different superscripts differ, P<.008.

[klm] Means with different superscripts differ, P<.10.

EFFECT OF ALFALFA HAY OR WHEAT STRAW LEVEL IN STEAM-FLAKED AND HIGH-MOISTURE CORN-BASED DIETS ON FEEDLOT PERFORMANCE AND CARCASS CHARACTERISTICS OF BEEF STEERS

by

A.S. Freeman, C.L. Jackson, and M.J. Vass

SUMMARY

A 153-day finishing trial using 192 English-continental crossbred yearling steers (avg wt 754 lb) evaluated the effects of alfalfa hay or wheat straw fed at either 10% or 6% in high concentrate diets based on steam-flaked or high-moisture corn on feedlot performance and carcass characteristics. Steers were randomly allotted to one of eight treatments in a 2 (roughage source) X 2 (roughage level) X 2 (corn processing) factorial arrangement with three pens of eight head each. Treatments were: 1) AHH, alfalfa hay at 10% as fed, with high moisture corn (HMC); 2) AHS, alfalfa hay at 10% with steam-flaked corn (SFC); 3) ALH, alfalfa hay at 6% with HMC; 4) ALS, alfalfa hay at 6% with SFC; 5) WHH, wheat straw at 10% with HMC; 6) WHS, wheat straw at 10% with SFC; 7) WLH, wheat straw at 6% with HMC; and 8) WLS, wheat straw at 6% with SFC. Wheat straw increased (P<.10) cumulative dry matter intake (CDMI) during the finishing trial. From day 85 to 153, wheat straw increased CDMI by 10% (P<.06). DMI decreased (P<.0001) for SFC-based diets during the entire feeding period. Cumulative ADG for steers consuming SFC was increased (P=.1095) by 4%. Roughage source by corn processing and roughage level by corn processing interactions (both P<.02) were detected from day 0 to 28 for feed conversion (F/G). Cumulative F/G was depressed (P<.004) from day 29 to 56 with 10% roughage level within HMC diets but was similar for SFC diets. From day 57 to 119, cumulative F/G was improved 14% by feeding SFC (P<.0001). Wheat straw depressed (P<.02) cumulative F/G by 4% from day 85 to 119 and by 6% overall (P<.0005). Cumulative F/G was depressed (P<.003) with 10% roughage level within HMC diets but was similar for SFC diets. Treatments did not affect (P>.10) adjusted final weight (avg 1204 lb), hot carcass weight (772 lb), marbling score (avg of 5.01), and yield grade (avg of 2.36). Rib-eye area was reduced (P<.04) 0.39 in^2 by wheat straw. HMC diets increased (P<.09) kidney-pelvic-heart fat by .16 percentage units. A three-way interaction was detected (P<.08) for adjusted backfat thickness. Yield grade was not affected (P>.10) by roughage source. Among steers consuming SFC diets with 10% and 6% roughage level and HMC with 6% roughage level, yield grade was similar. However, HMC at 10% roughage level decreased (P<.10) yield grade similarly to the SFC diets at 6% roughage level. Our data suggest that wheat straw inclusion in steam-flaked or high-moisture corn diets depressed feedlot performance but had minimal effects on carcass characteristics.

INTRODUCTION

Feed cost is the major expense in finishing cattle in confinement lots. More concentrates with lower roughage levels are being fed in today's feedlot rations. There are many reasons for feeding this type of diet. The two major objectives are: 1) reduction of the total feed bill by lowering the percentage of roughage, which is very costly feedstuff on a per energy unit basis compared with cereal grains and other ration ingredients, and 2) reducing the time on feed by increasing energy intake through an increase in the energy density of the ration.

However, problems can arise with a high concentrate-low roughage diet, if careful management of bunks and animals is not followed. Low quality roughages such as wheat straw could be effectively used in these high concentrate diets. The straw's physical, not nutritional, properties may help to lessen the occurrence of digestive and metabolic problems. Also, there is an abundant supply of wheat straw in Southwestern Kansas. An estimated 6.4 million tons of straw are produced annually in Kansas. Wheat straw is approximately one-third the cost of alfalfa hay. Therefore, the objective of this trial was to evaluate the effects of alfalfa hay or wheat straw fed at either 10% or 6% in high concentrate diets based on steam-flaked or high-moisture corn on feedlot performance and carcass characteristics.

EXPERIMENTAL PROCEDURES

A total of 212 English-continental cross-bred steers arrived at the center in two shipments during the middle of October 1989. Upon arrival, cattle were given fresh water and broken bromegrass hay bales (approximately 10 lbs hay per head) in feed bunks. All steers within a shipment were processed on the following day. Processing consisted of individual weights, ear tagging, tipping of horns, drenching with SafeGuard®, vaccination against IBR-PI_3-BVD-BRSV plus five strains of Leptospira, 7-way clostridial injection, and Tiguvon® pour-on. An IBR-PI_3 booster was given 14 days after the initial injection. Each animal was implanted once with a single Compudose® implant. Average weight was 647 lb.

After processing, steers were fed a starting ration of 65% dry rolled corn, 26% ground alfalfa hay, 6% blended molasses, and 3% pelleted supplement (see Table 1) on an as-fed basis. Approximately 15 lbs of the starter ration were offered to each animal. The bromegass hay was provided for an additional 4 days then removed from the diet. Cattle were fed once daily in the morning after the previous day's intake in each pen was determined from a 'bunk call'. Deccox® was fed to control coccidiosis for a 25-day period, then removed from the ration. After the decoquinate feeding period, monensin and tylosin were fed at 15g and 10 g/ton, respectively, for a 7-day period. The monensin level then was increased to 30g/ton for the duration of the feeding trial.

November 1989 proved to be a very dry and dusty month. Cattle in this trial experienced a setback caused by an outbreak of dust pneumonia. This respiratory condition extended the receiving period to 53 days, before the cattle were put on trial. During this time, cattle were accustomed to dietary step-ups, including yellow grease, high moisture corn, steam-flaked corn, and wheat straw until final finishing ration ingredient composition was reached (Table 1). The wheat straw was ground through a tub grinder with 3/4 inch screens. Particle length for the wheat straw varied from finely ground to coarse size of 3 inches in length.

Steers were placed on trial after no further sickness was present. An average of weights from 2 consecutive days was used as the trial starting weight (avg of 754 lb). On the second weigh day, 192 steers were randomly allotted to one of eight treatments in a 2 (roughage source) X 2 (roughage level) X 2 (corn processing) factorial arrangement with three pens of eight head each. Treatments were: 1) AHH, alfalfa hay at 10% as fed with high moisture corn (HMC); 2) AHS, alfalfa hay at 10% with steam-flaked corn (SFC); 3) ALH, alfalfa hay at 6% with HMC; 4) ALS, alfalfa hay at 6% with SFC; 5) WHH, wheat straw at 10% with HMC; 6) WHS, wheat straw at 10% with SFC; 7) WLH, wheat straw at 6% with HMC; and 8) WLS, wheat straw at 6% with SFC. Treatment nutrient analysis is given in Table 2.

Performance data collected during the feeding trial consisted of daily dry matter intake (DMI) for a pen, individual animal weights taken approximately every 28 days, calculation of individual average daily gain (ADG), and pen feed conversion (F/G). Cumulative DMI, ADG, and F/G were also calculated during the feeding trial. Carcass data were obtained at time of slaughter and(or) after a 24-hour chill at an area packer facility. Because the treatment design was a three factor arrangement (2 X 2 X 2 factorial), main effects of roughage source (alfalfa hay vs wheat straw), roughage level (10% vs

Table 1. Ingredient composition, of treatment diets as-fed basis.

	Treatments							
Ingredients[a]	AHH	AHS	ALH	ALS	WHH	WHS	WLH	WLS
Steam-Flaked Corn[b]		81		83.5		79.5		83.5
High-Moisture Corn[c]	82		85		80.5		84.5	
Alfalfa Hay	10	10	6	6				
Wheat Straw					10	10	6	6
Yellow Grease	2	2	2	1.8	2	2	2	2
Molasses	2	2	2	3	2	2	2	2
Supplement[d]	3	4	3.5	4.2	4.5	5	4.5	5
Cottonseed Meal	1	1	1.5	1.5	1	1.5	1	1.5

[a] Vitamins A, D_2, and E provided via a micro-weigh machine.
[b] Steam-Flaked Corn - 26 lb/bu; 18% moisture level.
[c] High-Moisture Corn was fed at 27% moisture level.
[d] Supplement - 51.8% CP, 7.4% urea, 10% calcium, .9% phosphorus, 4.5% NaCl.

Table 2. Percent dry matter nutrient analysis and cost per cwt for treatments.

	Treatments							
Nutrients	AHH	AHS	ALH	ALS	WHH	WHS	WLH	WLS
Dry Matter	63.1	70.1	63.2	70.2	64.1	69.8	64.9	69.8
Crude Protein	11.5	12.5	12.7	13.2	11.7	12.3	12.1	12.1
ADF[a]	4.2	5	5.4	5.4	9.8	8.8	7.5	7.2
TDN[b]	90	89	89	89	84	85	86	87
NEm, Mcal/cwt	106	105	104	104	97	99	101	101
NEg, Mcal/cwt	73	72	71	71	65	66	68	69
Calcium	.55	.64	.71	.68	.64	.82	.73	.78
Phosphorus	.28	.31	.31	.33	.28	.31	.29	.32
Potassium	.73	.82	.88	.85	.83	.86	.81	.81
Cost/ton,$	78.59	89.35	79.16	89.88	74.01	84.88	75.74	87.10

[a] ADF = Acid Detergent Fiber
[b] TDN = Total Digestible Nutreints

6%), and corn processing (high moisture vs steam flaking) plus all possible two-way and three-way interactions of these factors were examined.

RESULTS AND DISCUSSION

Feedlot Performance. All feedlot performance responses to treatments will be presented and discussed on a cumulative period basis. The trial consisted of 5 weigh days or periods with lengths of: 1) 0 to 28 days, 2) 0 to 56 days, 3) 0 to 84 days, 4) 0 to 119 days, and 5) 0 to 153 days. Periods 1 through 3 were in 28-day intervals, but 4 and 5 were 35 and 34 days, respectively.

Dry Matter Intake. Cumulative dry matter intake (CDMI) was not affected (P<.10) by roughage level up to 84 days on feed. No two-way or three-way interaction effects on CDMI were present during the 153-day feeding trial. However, during the first 84 days, CDMI was increased 5.2% by wheat straw (P<.04; Figure 1) and 13.8% by high moisture corn (P<.0001; Figure 2). Steers consuming wheat straw diets ate 3.8% more (P<.09) dry matter compared with those eating alfalfa-based diets. High-moisture corn inclusion caused an 11.5% increase (P<.0001) in CDMI compared to steam-flaked corn diets. By 119 days on feed, steers receiving 10% roughage on an as-fed basis were consuming 4.6% more (P<.06) dry matter than steers on the 6% roughage level treatments (Figure 3). The 10% roughage level increased (P<.03) intake by 4.9% for the entire feeding trial.

The wheat straw effect on intake was probably not due to its bulky form, because no roughage level by source interaction was detected. However, wheat straw probably did stimulate intake by increasing

Figure 1. Main effects of roughage source on cumulative dry matter intake by weigh period. Means for each successive period differ; P<.05, P<.03, P<.04,P<.09 and P<.09, respectively.

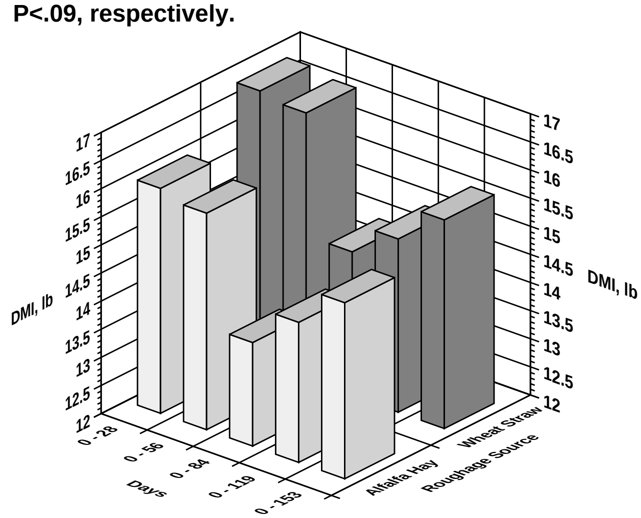


Figure 2. Main effect of corn processing method on cumulative dry matter intake by weigh periods. Means are different, P<.0001.

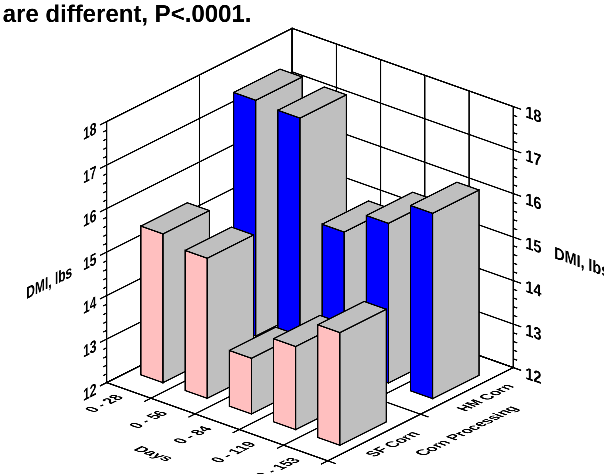
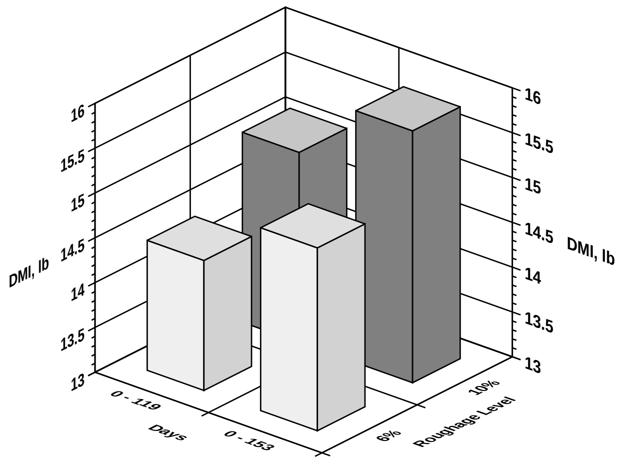


Figure 3. Main effect of roughage level on cumulative dry matter intake at 119 (P<.06) and 153 (P<.03) days on feed.



rumination time (cud chewing). Greater reduction in particle size of ingested diet by increased cud chewing would cause an increase in rate of digesta passage through the steers, allowing for increased intake.

The SFC-based diets were more energy dense (Table 2) than the HMC-based diets. Thus, each unit of intake of the SFC diets would provide more energy. Consequently, more of the HMC diet would need to be consumed to provide an equivalent amount of energy. The increased intake caused by the 10% roughage level during the last 70 days of the feeding trial was also probably due to the diets lower energy density compared to the 6% roughage level diets.

Average Daily Gain. During the first period, an interaction of roughage level and corn processing affected (P < .07) average daily gain (ADG; Table 3). By 28 days on feed, cattle consuming SFC diets at a roughage level of 10% had improved gains over those consuming HMC at the same roughage level. However, the opposite was true at the 6% roughage level; gains were improved by HMC compared with SFC diets. These gain differences were probably a function of increased intake for the HMC-6% roughage level diets and lower energy density of the HMC-10% roughage level diets during the first period. Roughage source by corn processing interaction only marginally affected (P = .1182) ADG. No other treatment effects on ADG were observed until the end of the feeding trial. Cumulative ADG for steers consuming SFC-based diets (2.85 lb) was 4% greater (P < .09) compared with HMC diets (2.74 lb). This response may be an indication of improved utilization through increased ruminal starch fermentation of the steam-flaked grain.

Feed Conversion. Generally, cumulative feed conversion (F/G) was depressed by wheat straw, the 10% level of roughage, and high-moisture corn up to 119 days on feed. Overall cumulative F/G was improved 6.3% with alfalfa hay (5.36; P<.0003) in the diet at either level compared with wheat straw (5.70). However, roughage level did affect feed conversion, but response depended on which corn was fed (Figure 4; P<.008). Steers consuming SFC, at both roughage levels, converted an average of 5.12 lb of dry matter to 1 lb of live weight gain. Cattle fed HMC diets at the 6% roughage level required 11.9%

Figure 4. Roughage level and corn processing method effects on cumulative feed conversion. Means differ with different letters. P<.008.

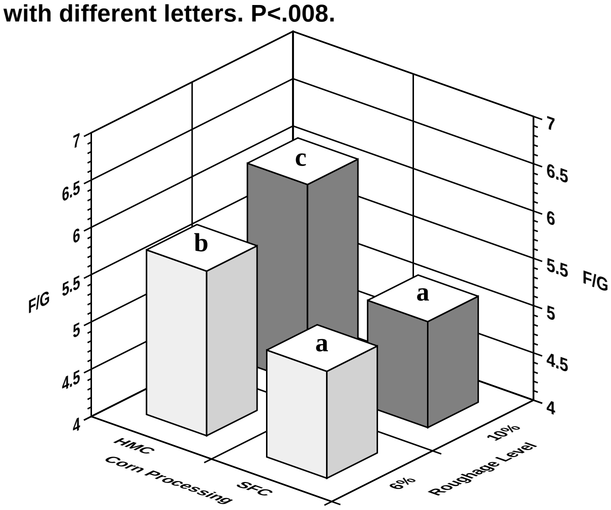


Table 3. Roughage source, level and corn processing effects on average daily gain in beef steers.

Period	Treatments							
	AHH	AHS	ALH	ALS	WHH	WHS	WLH	WLS
0-28	3.36[a]	3.28[abc]	3.61[c]	3.26[ac]	3.14[a]	3.53[abc]	3.44[c]	3.38[ac]
0-56	2.80	2.82	2.87	2.87	2.66	2.99	2.88	3.03
0-84	2.76	2.79	2.70	2.75	2.73	2.99	2.78	2.79
0-119	2.88	2.77	2.70	2.83	2.73	2.94	2.71	2.82
0-153	2.84[d]	2.87[e]	2.74[d]	2.85[e]	2.67[d]	2.91[e]	2.72[d]	2.76[e]

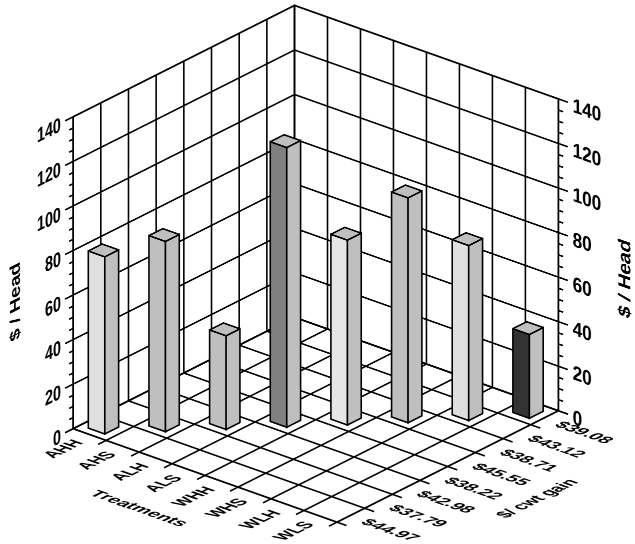
[abc] Interaction of roughage level and corn processing. Means with different superscripts differ, P<.07.
[de] Main effect of corn processing, P<.09.

more feed per lb of gain compared with cattle fed the SFC diets. An additional pound of feed was needed per lb of gain for HMC with 10% roughage level compared with the SFC diets. The 10% roughage level depressed F/G by 6.2% compared to the 6% roughage level in the HMC diets.

Carcass Characteristics. Treatment effects on carcass characteristics are given in Table 4. Treatments did not affect (P>.10) adjusted final weight (avg 1204 lb), hot carcass weight (avg 772 lb), marbling score (avg 5.01), and yield grade (avg 2.36). Rib-eye area was reduced (P<.04) 0.39 in^2 by wheat straw. HMC diets increased (P<.09) kidney-pelvic-heart fat by .16 percentage units. A three-way interaction was detected (P<.08) for adjusted backfat thickness. Dressing percentage was decreased (P < .04) 0.5 percentage units by wheat straw compared with alfalfa hay.

The differences in carcass characteristics seen in this study do not appear to be of economic concern. However, as shown in Figure 5, cattle receiving the 6% alfalfa hay, steam-flaked corn diet provided the greatest net return per head. There was a $.92 difference in the cost per cwt gain between 10% wheat straw in SFC ration and the 6% alfalfa hay SFC ration, but a $24.60 net return per head more was realized with the 6% alfalfa hay SFC ration. Dry matter feed conversions are given below Figure 5 for each treatment. Our data suggest that wheat straw inclusion in steam-flaked or high-moisture corn diets depressed feedlot performance but had minimal effects on carcass characteristics.

Figure 5. Cost per cwt gain and net return by treatments. The intersection of a treatment and cost per cwt gain will give the net return per head in that treatment.



Treatments:	AHH	AHS	ALH	ALS	WHH	WHS	WLH	WLS
F/G:	5.88	4.89	5.63	5.03	6.36	5.35	5.86	5.22

Table 4. Roughage source, level, and corn processing effects on carcass characteristics in beef steers.

	Treatments							
Item	AHH	AHS	ALH	ALS	WHH	WHS	WLH	WLS
Adj. Wt, lb	1214	1209	1207	1223	1203	1240	1185	1204
HCW., lb	777	774	772	783	770	794	759	770
REA, in^2	13.6[a]	14.0[a]	14.0a	14.0[a]	13.3[b]	13.8[b]	13.6[b]	13.4[b]
Back Fat, inc.	.32[c]	.28[d]	.30c[d]	.31[ce]	.28[d]	.30[cd]	.29[de]	.29[de]
KPH Fat, %	3.0[f]	2.8[g]	3.0[f]	2.7[g]	2.7[f]	2.7[g]	2.9[f]	2.7[g]
Marbling Score	5.08	5.01	4.95	5.09	5.06	4.98	4.87	5.07
Quality Grade	Ch[08]	Ch[01]	Sl[95]	Ch[09]	Ch[06]	Sl[98]	Sl[87]	Ch[07]
DP,%	63.2[a]	63.0[a]	63.0[a]	63.5[a]	62.2[b]	62.9[b]	63.0[b]	62.9[b]
Yield Grade	2.5	2.2	2.3	2.3	2.4	2.4	2.3	2.4

[ab] Main effect of roughage source, P<.04.
[cde] Three-way interaction effect of source X level X corn processing. Means with different superscripts differ, P<.10.
[fg] Main effect of corn processing, P<.09.

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INFLUENCE OF THREE PROTEIN LEVELS AND ADDED FAT IN FINISHING DIETS ON FEEDLOT PERFORMANCE AND CARCASS CHARACTERISTICS OF LARGE-FRAMED BEEF STEER CALVES

by
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SUMMARY

Two-hundred forty English-continental crossbred large-framed calves with an average initial weight of 643 lb were used in a 168-day finishing trial to evaluate effects of three dietary protein levels and added fat on feedlot performance and carcass characteristics. Forty calves were allotted to one of six treatments with five pens of eight head each. The diet consisted of 58% steam-flaked corn, 19% dry-rolled corn, 9.75% corn silage, and 6.5% of a pelleted supplement on a dry matter basis. Yellow grease was added at 4% on a dry matter basis to some treatments. Corn gluten meal and blood meal were used to adjust dietary protein levels. Treatments were: 1) LPNF, 11.8% crude protein (CP; dry matter basis) with no added fat; 2) MPNF, 12.8% CP, no fat; 3) HPNF, 13.8% CP, no fat; 4) LPAF, 11.8% CP with added fat; 5) MPAF, 12.8% CP, added fat; 6) HPAF, 13.8% CP, added fat. Dry matter intake, average of 17.8 lb, was not affected by increasing protein levels or added fat for the 168-day feeding period. During the first 41 days on feed, average daily gain (ADG) was increased (P<.02) linearly with increasing protein level with or without added fat; LP, 3.84, MP, 4.12 and HP 4.25 lb. However, cumulative ADG was not affected by the treatments; average of 3.73 lb. Overall feed conversion was improved 3.8% by the added fat (P<.03) but was not affected by protein level. Dressing percent was increased (P<.004) by the MPAF and HPAF diets. Added fat increased (P<.10) rib-eye area by 0.31 in^2. The MP steers had the largest rib-eye area of 14.5 in^2 (P<.04) compared to an average of 13.9 in^2 for the LP and HP steers. Added fat also increased (P<.006) kidney-heart-pelvic fat by .24 percentage units. Adjusted back fat thickness was affected by both protein level and added fat; an interaction was present. These data suggest that supplemental dietary fat additions to high concentrate diets do not alter the protein requirements of rapidly growing, large-framed, beef steer calves.

INTRODUCTION

Performance level or rate of gain will dictate the nutrients, specifically energy and protein, needed by a particular animal in your production system. Rapidly growing beef steers require between 48 and 86 Mcal of net energy for maintenance and 23 to 57 Mcal of net energy for production per 100 lb of dry feed consumed to achieve daily gains ranging from .5 to 3.5 lb. Protein requirement expressed on a percentage basis of total intake decreases as animal weight increases. However, because of the increased intake at higher body weights, total protein intake increases as the animal matures. Protein intake ranges from .77 to 2.28 lb per head daily stipulated by a given starting weight and rate of gain.

As an animal matures, it's net energy requirement for maintenance and production and protein needs change. Also, energy or calorie to protein ratio is altered by advancing maturity. Because feed cost can be greater than 70% of the cost of gain and protein is an expensive nutrient, targeting a calorie to protein ratio for a specific stage of production would be cost effective. Additionally, protein is 'spared' for lean deposition when adequate energy is available for overall growth. Therefore, this study was conducted to evaluate three graded levels of crude protein, 11.8, 12.8,and 13.8% without fat or with 4% added fat on the feedlot performance and carcass characteristics of rapidly growing beef calf steers.

EXPERIMENTAL PROCEDURES

Two-hundred forty large-framed English-continental crossbred calves with an average initial weight of 643 lb were received in late November of 1989. Calves were given access to fresh water and brome grass hay. All calves were processed on the following day by standard SWKREC procedures. Cattle were implanted with Synovex-S® at arrival and re-im-

Table 1. Percent composition of step-up period and finishing diets, as-fed basis.

	Step-Up				No Added Fat			Added Fat		
Ingredient	1	2	3	4	LPNF	MPNF	HPNF	LPAF	MPAF	HPAF
Corn										
Dry-Rolled	45	51	59	65						
Steam-Flaked					56.2	55.3	54.4	53.4	52.5	51.6
Alfalfa Hay	33	22	11	4						
Corn Silage	15	18	20	20	21.8	21.8	21.9	21.9	22.0	22.0
Molasses	5	5	5	5						
Yellow Grease	1	1	1	1				2.9	2.9	2.9
Supplement										
Step-up	1	3	4	5						
Finisher*					5.14	5.14	5.15	5.17	5.18	5.18
Corn Gluten Meal						.69	1.38	.56	1.25	1.95
Blood Meal						.46	.91		.46	.92

Step-up period was 20 days.
Finishing period was 168 days, from Nov. 29 to May 16, 1990.
*Finisher supplement provided 0.75% urea in all treatments.

planted on day 84 with Synovex-S® and Finaplix-S®. Diets step-ups are given in Table 1. The receiving period lasted 20 days, during which Deccox® was being fed for coccidiosis control.

After the receiving period, all cattle were individually weighed over a 2-day period and allotted to pens and treatments. Steers were allotted to one of six treatments with five pens of eight head each. Treatments were: 1) LPNF, 11.8% crude protein (CP; dry matter basis) with no added fat; 2) MPNF, 12.8% CP, no fat; 3) HPNF, 13.8% CP, no fat; 4) LPAF, 11.8% CP, with added fat; 5) MPAF, 12.8% CP, added fat; 6) HPAF, 13.8% CP, added fat. Ingredient composition of dietary treatments are given in Table 1. Yellow grease was added at 4% on a dry matter basis to provide supplemental fat. Corn gluten meal and blood meal were used to adjust dietary protein levels. The calves were fed once in the morning for the 168-day finishing trial. Table 2 provides the nutrient analysis of treatment rations. After the receiving period, calves were adjusted to monensin over a 28-d period (Table 2). Carcass characteristics were determined at slaughter and after a 24-hour chill. Liver abscess data were collected at time of slaughter.

Table 2. Percent nutrient composition of finisher treatment diets, dry matter basis.

	No Added Fat			Added Fat		
Nutrient	LPNF	MPNF	HPNF	LPAF	MPAF	HPAF
Dry Matter	70.5	68.6	68.9	69.6	69.5	69.8
Crude Protein	11.8	12.8	13.8	11.8	12.8	13.8
Acid Detergent Fiber	4.04	7.13	6.50	7.20	7.07	6.90
Total Digestible Nutrients	87.6	86.8	87.5	86.7	86.9	87.1
Net Energy main., Mcal/cwt	95.9	95.6	95.4	101.7	101.4	101.1
Net Energy gain, Mcal/cwt	64.0	63.8	63.6	68.2	68.0	67.8
NEg to Protein, Mcal/CP	5.42	4.98	4.61	5.78	5.31	4.91
Calcium	.51	.67	.51	.54	.52	.59
Phosphorus	.25	.25	.27	.25	.26	.25
Magnesium	.10	.11	.11	.10	.11	.11
Potassium	.66	.75	.67	.67	.67	.71

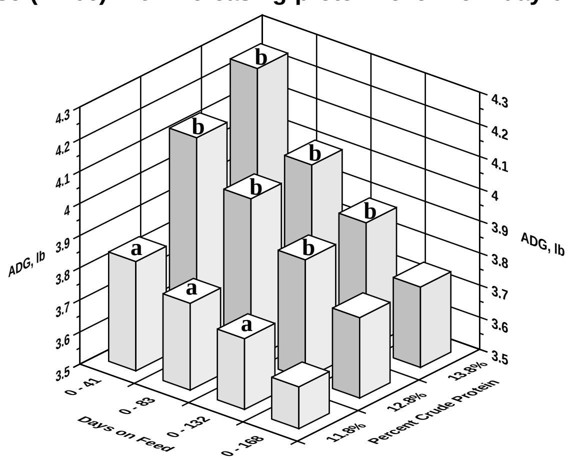
Rumensin® and Tylan® were fed at 15 and 10 g/ton, respectively for 2 weeks, then Rumensin was increased to 30 g/ton.

RESULTS AND DISCUSSION

Feedlot Performance. Feedlot performance results are given in Table 3. Dry matter intake (DMI) was not affected (P>.10) by protein or fat levels. Overall average DMI was 17.8 lb daily per steer for the 168-day feeding period. A trend for decreased intake was noted for calves consuming the added fat diets. As energy density increases, intake will drop somewhat. Within a fat level, DMI appeared to increase with increasing levels of protein. Intake usually responds positively with increasing percentage of protein in the diet.

Average daily gain (ADG) was not affected (P>.10) by treatments. However, ADG was increased linearly (P<.06) up to 132 days on feed (Figure 1). The protein level marginally affected ADG (P<.1012) during period 3 (day 84 to 132). This suggests that, as these calves were maturing or with more days on feed, their protein requirement for growth was probably being met as a result of increased intakes. Also, a crude protein content of 12.8% with added fat for the entire 168-day feeding period seems sufficient to maintain acceptable performance. For the entire feeding period, ADG averaged 3.73 lb daily.

Figure 1. Main effect of protein levels on cumulative average daily gain during finishing period. Linear increase (P<.06) with increasing protein level from day 0-132.



During the first period (day 0 - 41), protein level effects on feed conversion were not acting independently of fat addition, as seen by their interaction (P<.07) in Figure 2. Steers receiving no added fat (Figure 2), converted less feed to live weight gain than steers receiving added fat. As protein level increased (Figure 2), steers receiving no added fat became more efficient in a linear manner. However, steers receiving added fats, responded to increasing protein levels in a curvilinear fashion. Feed conversion was improved (P<.06) by added fat 3.2% and 3.8% after 132 and 168 days on feed, respectively (Figure 3). The added fat did not seem to alter these calves' protein requirements, because no protein level by fat interaction was observed for cumulative

Figure 2. Feed conversion for day 0-41. Protein level by added fat interaction (P<.07) was evident.

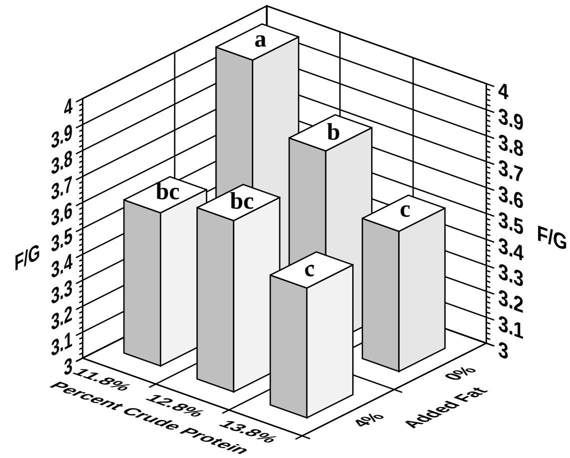
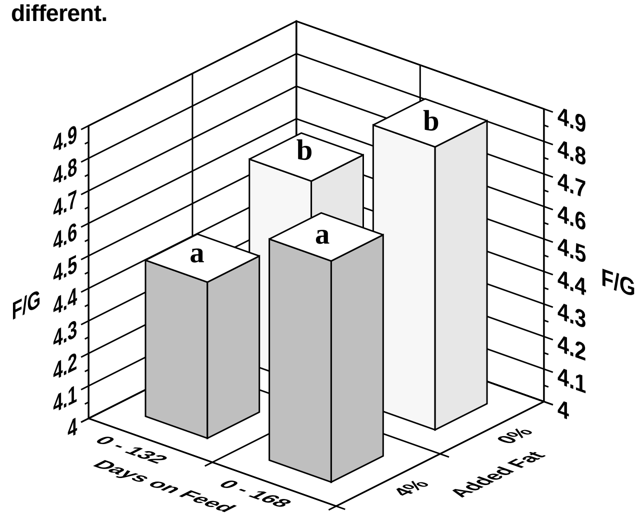


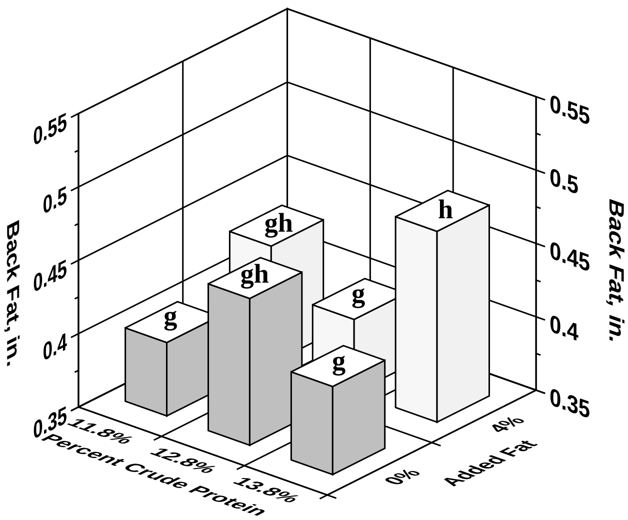
Figure 3. Main effect of fat on feed conversion from days 0-132 and 0-168 (P<.05). Within a feeding period, means are different.



feedlot performance.

Carcass Characteristics. Hot carcass weight (HCW) was not affected by treatments (Table 3; P>.10). However, diets containing the added fat appeared to have a more consistent response of increasing HCW compared with no fat addition. Dressing percent was increased 0.9 percentage units by the added fat (P<.004). Increasing protein level also increased (P<.03) DP in a linear manner. Ribeye area was increased 2.9% by the added fat (P<.0001). A protein level quadratic response (P<.0001) for REA was observed; 13.9 for LP, 14.5 for MP, and 14.0 in^2 for HP. In this study, MP provided the largest REA compared with LP and HP. It is possible that the additional 1% CP in the HP diets was being converted to energy rather than directed towards lean deposition. A protein level by fat addition interaction (Figure 4; P<.006) was evi-

Figure 4. Protein level by added fat interaction (P<.006). Means differ with unlike superscripts.



dent for adjusted back thickness (ABF; Figure 4). Within the NF group, ABF peaked at MP then declined (Figure 4). While, in the AF group, the opposite was true; ABF was thinnest at the MP level then increased to .48 in. with HP the diet (Figure 4). The steers' KPH percent was increased (P<.0001) by the added fat. The average marbling score was 4.95, which is equivalent to a Slight^{95} quality grade. Yield grade was an average of 2.6, and retail yield averaged 50.8%. Liver abscesses were not affected (P>.10) by treatments.

Economic Considerations. Economic return for this trial is presented in Figure 5. Treatments are listed along the X-axis and each treatment's corresponding cost per cwt weight gain along the Z-axis. Cost of gain labeling along the Z-axis is opposite to treatment labeling so that the intersection of a treatment and cost of gain will be the net return per head for that treatment. First examination of the treatments cost per gain indicates that not including the added fat in these diets would be more cost effective. However, improved feed conversion and

Table 3. Effect of protein and fat on feedlot performance and carcass characteristics of large-framed, finishing, beef steer calves.

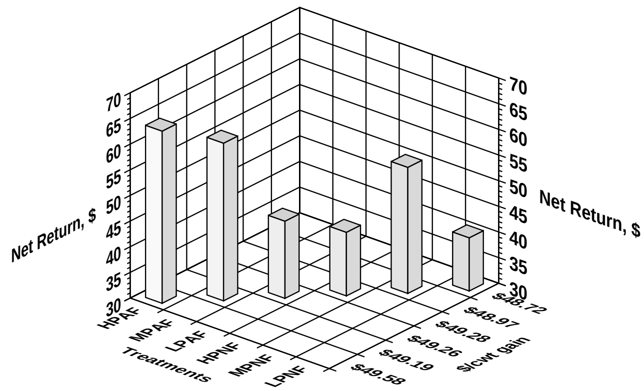
	No Added Fat			Added Fat		
Item	LPNF	MPNF	HPNF	LPAF	MPAF	HPAF
Feedlot Performance						
No. of Pens	5	5	5	5	5	5
No. of Steers	40	40	40	40	40	40
Initial Wt., lb	646	645	641	642	640	641
Final Wt., lb	1259	1264	1259	1248	1280	1281
Adj. Final Wt., lb[a]	1195	1217	1204	1200	1233	1241
Dry Matter Intake, lb	17.8	17.9	17.9	17.0	17.7	17.8
Daily Gain, lb	3.65	3.69	3.68	3.61	3.81	3.81
Feed Conversion[b]	4.88	4.87	4.87	4.72	4.65	4.67
Carcass Characteristics						
Hot Carcass Wt., lb	782	797	788	785	807	812
Dressing Percent, %[cd]	64.7	65.6	65.2	65.5	65.7	66.0
Rib-Eye Area, in.^{2}[ef]	13.7	14.2	13.9	14.0	14.7	14.0
Kidney-Pelvic-Heart Fat, %[e]	2.1	2.3	2.3	2.4	2.5	2.5
Marbling Score	5.1	5.1	4.8	4.9	4.9	4.9
Quality Grade	Ch^{10}	Ch^{10}	Sl^{80}	Sl^{90}	Sl^{90}	Sl^{90}
Yield Grade	2.5	2.6	2.5	2.6	2.4	2.8
Retail Yield, %	50.9	50.8	50.9	50.8	51.3	50.2

[a] Adjusted with an average DP of 65.46%; Adj. Final Wt = HCW/.6546.
[b] Main effect of fat level, P<.052.
[c] Main effect of fat, P<.004.
[d] Linear effect of protein, P<.03.
[e] Main effect of fat, P<.0001.
[f] Quadratic effect of protein, P<.006.

increased carcass weights for the added fat treatments groups provided the greatest return per head; LPAF $45.04, MPAF $60.72, and HPAF $63.55. Net return for the MPNF ($54.57) group was increased above the other NF treatments because of the lower ration cost compared with HPNF ($42.39) and better feed efficiency compared with LPNF ($40.36).

In conclusion, the protein requirements of large-framed English-Continental cross-bred calves was not affected by added fat as yellow grease in their finishing diets. However, the 13.8% CP with 4% added fat on a dry matter basis produced the greatest net return per steer conpared with other protein-added fat combinations.

Figure 5. Cost per cwt gain and net return by treatments. The intersection of a treatment and cost/cwt gain will give the net return per head in that treatment.



EFFECT OF THREE TEST WEIGHTS OF GRAIN SORGHUM ON PERFORMANCE OF GROWING BEEF STEERS*

by
A. S. Freeman, K. K. Kreikemeier, and G. L. Kuhl

SUMMARY

A growing trial with 180 yearling steers (avg wt 546 lbs) was conducted to evaluate the feeding value of 35, 45, and 55 lb/bu grain sorghum in either limit-fed high concentrate (HC) or full-fed high roughage (HR) diets for 112 days. Six dietary treatments of dry rolled grain sorghum were used: 1) HC35; 2) HC45; 3) HC55; 4) HR35; 5) HR45; and 6) HR55. Steers were limit fed to gain an average of 2 lb daily. Treatments were replicated in five pens with six steers per pen. Growing phase performance was affected (P<.06) by feeding level (limit-fed HC vs full-fed HR). Full-fed HR steers gained 31% more than limit-fed HC steers. Full-fed HR steers were 76 lb heavier compared with limit-fed HC steers. Within a feeding level, steers consuming 35 and 45 lb/bu milo tended to be heavier than those consuming 55 lb/bu milo. Dry matter intake for HR55 steers (21.0 lb) was 5.5% more (P<.06) compared with HR35 and HR45 steers (avg 19.85). Dry matter intake for HC steers averaged 13.6 lb. Within a feeding level, average daily gain (ADG) was not affected by sorghum test weight; however, ADG tended to decrease with increasing test weight. An 11.4% improvement in feed conversion for HC steers (P<.001) was realized compared with HR steers. Across feeding levels, a trend for improved feed conversion was evident for steers consuming 35 and 45 lb/bu milo compared with 55 lb/bu milo. Light test weight grain sorghum (35 and 45 lb/bu) was superior to or comparable to normal sorghum (55 lb/bu) in feeding value when fed in a limit-fed, high concentrate or full-fed, high roughage, growing diet for yearling beef steers.

INTRODUCTION

The bulk density of sorghum can be lowered by trash in the grain, prolonged damp weather causing pre-harvest sprouting, or from an early freeze that stops plant maturity. Reduced yields are often associated with light test weight sorghum, and most livestock producers and nutritionists perceive its feeding value to be inferior to US No. 2 grain sorghum (55 lb/bu). Under current market conditions, 45 lb/bu sorghum is discounted 6% and 35 lb/bu sorghum suffers a 15% to 50% discount on a pound for pound basis.

Research indicates that sprouted sorghum has nearly identical feeding value compared to normal sorghum in cattle diets. Across three experiments, the feeding value of sprouted sorghum varied from 97 to 103% compared to normal sorghum. Even though several trials have been conducted with frost-damaged sorghum across various species, the results are less conclusive.

In addition, no data evaluating steam-flaked light test weight sorghum were found. Because early frost and its effect on sorghum feeding value is a concern to producers, it is important to establish the current feeding value of light test weight sorghum fed to modern type beef cattle in a growing and finishing feedlot program.

EXPERIMENTAL PROCEDURES

Through the cooperation of Kansas County Ag Agents and local elevators, 675,000 lb of sorghum was available at local elevators in Pawnee County. This included 225,000 lb each of 35, 45, and 55 lb test weight sorghum. All the sorghum was from the 1989 crop. Because the grain originated in one county and the grain in each test weight was thoroughly mixed, the variation associated with sorghum variety and environment was reduced. This enabled precise interpretation of the feeding performance data to evaluate true 'test weight' effects.

The yearling steers were purchased through an order-buyer, who obtained the cattle from Sikeston, MO. A group of 180 was selected from a total of 195 head to be used in the growing and finishing phases of this study. Cattle breeds represented by the lot included Angus-Hereford-Brahman crossbred dams bred to Simmental-Charolais-Limousin sires.

The cattle arrived at the center on August 13, 1990. Average pay weight was 519 lb. Upon arrival, steers were given access to fresh water and approximately 10 lb of brome grass hay and alfalfa hay mixture per head. All cattle were processed on the following morning. Processing included individual weights, ear tagging, dehorning, administration of an IBR-PI_3 nasalagen, vaccination against clostridial (7-way) and Haemophilus somnus organisms, a high potency multi-B complex vitamin injection, implanting with an implant containing 24 mg of estradiol, and de-worming with albenazole. Cattle were vaccinated with an IBR-PI_3-BVD-BRSV injection, and fenthion was poured on to control grubs and lice. All cattle were re-vaccinated with IBR-PI_3-BVD 14 days later on August 30.

Starting diet for all steers consisted of 14.73% of each grain sorghum test weight, 12.85% corn silage, 37.68% ground medium quality alfalfa hay, 3.28% blended molasses, and 2% of a 48% crude protein pelleted supplement. Decoquinate was fed at a rate of 180 mg per head daily for 28 days to control coccidiosis. Dietary ingredients were changed over the 28 receiving-decoquinate period to final dietary treatments (Table 1). The decoquinate was removed and replaced with 150 mg of monensin and 90 mg of tylosin per head daily for a 14-day period. Then, the monensin was increased to 280 mg per head daily for the remaining days in the growing phase. Nutrient composition of the three grain sorghums is given in Table 2.

Initial body weights were obtained from the average weights on 2 consecutive days. Treatments were randomly allotted to pens with five pens per treatment. The steers were randomly allotted to treatments by weight, condition, frame score, and breed type. There were six steers per pen with 30 head per treatment. Every 28 days, steers were individually weighed to obtain weight gain. Final weights for the growing phase were an average of weights on 2 consecutive days.

Table 1. Diet composition and dry matter nutrient analysis.

Item[a]	Limit Fed			Full Fed		
	HC35	HC45	HC55	HR35	HR45	HR55
	- - - - - - - - - - - - - % - - - - - - - - - - -					
Ingredients						
Grain Sorghum	80.3	76.9	76.1	37.8	37.2	36.9
Alfalfa Hay	6.8	13.3	14.2	29.1	30.5	30.7
Corn Silage	6.2	3.4	3.0	26.2	25.2	25.4
Molasses	4.3	4.1	3.7	5.4	5.4	5.1
Supplement	2.4	2.3	3.0	1.5	1.7	1.9
Nutrients						
Dry Matter						
Crude Protein	12.9	12.6	12.5	12.6	13.1	12.5
ADF[b]	9.8	12.5	8.4	22.1	23.8	21.2
TDN[b]	83.7	80.4	85.3	75.7	74.2	76.6
Calcium	.37	.62	.45	.56	.58	.6
Phosphorus	.34	.32	.35	.28	.31	.28
Magnesium	.16	.17	.17	.21	.20	.20
Potassium	.99	1.08	1.09	1.50	1.57	1.52
NEm, Mcal/cwt[c]	89	94	97	76	79	81
NEg,Mcal/cwt[c]	57	62	66	48	50	52

[a] Monensin, 280 mg and Tylosin 90 mg per head daily.
[b] ADF = Acid Detergent Fiber.TDN = Total digestible nutrients.
[c] Calculated from steer performance.

Table 2. Dry matter nutrient composition of grain sorghums.

Nutrient[a]	Grain Sorghum Test Weight		
	#35	#45	#55
	- - - - - - - - - % - - - - - - - -		
Dry Matter	86.7	86.0	85.1
Crude Protein	13.3	11.9	11.4
Acid Detergent Fiber	12.0	7.0	3.8
TDN	81.0	86.9	90.8
Calcium	.08	.04	.02
Phosphorus	.42	.35	.33
Magnesium	.21	.16	.15
Potassium	.57	.50	.47
NEm, Mcal/cwt[b]	94	102	107
NEg, Mcal/cwt[b]	61	69	74

[a] TDN = Total digestible nutrients. Percentage values.
[b] Calculated from nutrient analysis.

Feed intake was determined on a pen basis. Limit-fed steers' intake was determined from National Research Council net energy equations to provide enough dietary energy and protein for an average of 2 lb daily gain. Full-fed steers were allowed ad libitum intake without excessive accumulation of feed on a daily basis. Cattle were fed once daily in the morning with intake being adjusted to the previous day's intake through a daily 'bunk call'. Weekly dietary treatment samples were obtained from each bunk to determine dry matter intake.

RESULTS AND DISCUSSION

Weight Changes. Initial weight of all cattle on trial was 546 lb (Table 3). Sorghum test weight did not affect full live weight changes during the 112-day growing trial. No feeding level by test weight interaction was found either. However, HR or full-fed steers gained from at least 5% to 8% more live weight compared with HC or limit-fed steers. By 56 days on feed, HR steers were 39 lb heavier ($P<.03$) than HC steers. The weight difference between HR and HC steers increased to 49 lb ($P<.003$) then to 76 lb ($P<.0001$) by 84 and 112 days on feed, respectively. Feeding levels were greatly influenced by amount of intake and physical aspects of the diets, i.e., increased amount of intake and gut fill with the high roughage full-fed diets.

Table 3. Live weight changes (lb) of steers during growing phase.

	Limit-Fed			Full-Fed			
Item	HC35	HC45	HC55	HR35	HR45	HR55	SEM[a]
Initial Wt.	548	546	543	545	544	547	20
Day 28	630	637	622	659	647	651	18
Day 56[b]	686	686	675	726	719	719	21
Day 84[c]	761	761	750	813	801	803	17
Day 112[d]	799	794	781	873	865	860	19

[a] SEM = Standard error of the means, n = 30 steers.
[b] Feeding level main effects, HC vs HR, P<.03.
[c] Feeding level main effects, HC vs HR, P<.003.
[d] Feeding level main effects, HC vs HR, P<.0001.

Dry Matter Intake. Cumulative dry matter intake (DMI) is given in Table 4. For the first 56 days, dry matter intake was not affected by sorghum test weight. Within HC feeding level, there was a trend for steers consuming the 35 lb and 45 lb sorghum to consume more dry matter. However, the opposite was true for steers consuming the 35 lb and 45 lb sorghum in the HR feeding level. The HR55 steers tended to consume more dry matter compared with the HR35 and HR45 steers. By 84 days, a feeding level by test weight interaction was evident (P<.10). HC steers' DMI was an average of 13.5 lb and DMI for the HR35 and HR45 steers was 19 lb. HR55 steers' DMI was 5.5% more (P<.10) compared with HR35 and HR45 steers. Overall DMI was also affected (P<.06) by sorghum test weight at each feeding level. By 112 days, DMI for HR55 steers (21.0 lb) was 5.5% more (P<.06) compared with HR35 and HR45 steers (avg 19.85). Overall DMI for HC steers' averaged 13.6 lb. Within limit-fed steers, there was a trend for increased intake as test weight decreased, but just the opposite trend for the full-fed steers.

Table 4.Cumulative dry matter intake (lb) of steers during growing phase.

	Limit-Fed			Full-Fed			
Item	HC35	HC45	HC55	HR35	HR45	HR55	SEM[a]
Day 0-28[b]	13.2	13.0	13.1	16.5	16.0	17.5	.39
Day 0-56[b]	13.4	13.1	13.0	17.6	17.8	18.7	.40
Day 0-84	13.7[c]	13.5[c]	13.3[c]	19.0[d]	19.0[d]	20.1[e]	.36
Day 0-112	13.8[f]	13.7[f]	13.4[f]	19.8[g]	19.9[g]	21.0[h]	.34

[a] SEM = Standard error of the means, n=30 steers.
[b] Feeding level main effects, HC vs HR, P<.0001.
[cde] Feeding level by test weight interaction, P<.10.
[fgh] Feeding level by test weight interaction, P<.06.

Average Daily Gain. During the first 28 days, a feeding level by test weight interaction was observed (Table 5). The HC35 and HC55 steers gained 12.7% less (P<.02) compared with HC45 steers, 2.88 vs 3.24 ADG, respectively. However, HR35 steers' ADG (4.06 lb) was improved (P<.02) by 10% over HC45 and HC55 steers (avg 3.69 ADG). Within a feeding level, ADG was not affected by sorghum test weight; however, ADG tended to decrease with increasing test weight. This non-significant linear trend was probably due to the decreasing intake within the limit-fed steers. But, because a trend was noted for decreasing intake with increasing test weight for the full-fed steers, nutrient utilization by full-fed steers tended to be more efficient with decreasing test weight.

Table 5. Cumulative average daily gain (lb) of steers during growing phase.

	Limit-Fed			Full-Fed			
Item	HC35	HC45	HC55	HR35	HR45	HR55	SEM[a]
Day 0-28	2.93[e]	3.24[d]	2.82[e]	4.06[b]	3.66[c]	3.72[c]	.12
Day 0-56	2.46	2.50	2.35	3.23	3.12	3.08	.07
Day 0-84[f]	2.54	2.56	2.46	3.19	3.06	3.05	.08
Day 0-112[f]	2.24	2.21	2.12	2.92	2.86	2.80	.07

[a] SEM=Standard error of the means, n=30 steers.
[bcde] Feeding level by test weight interaction, P<.02.
[f] Feeding level main effects, HC vs HR, P<.0001.

Feed Conversion. Feed conversion and cost of gain are presented in Table 6 on the following page. Feeding level did not affect feed to gain ratio during the first 28 days. But there was a main effect (P<.04) and quadratic response to test weight (P<.10). Steers consuming 45 lb sorghum required 2% less feed compared with steers consuming 35 lb and 55 lb sorghum, respectively. Within a feeding level (HC vs HR, P<.04), increasing sorghum test weight (main effect, P<.1014) caused a linear decrease in feed conversion (P<.06). By 112 days, test weight had no effect on feed to gain ratio. However, within a feeding level (main effect, P<.0005), a trend for improved feed conversion as test weight decreased was evident. Cost of gain presented in Table 6 is based only on the ration cost on an as-fed basis. Other costs incurred during a growing phase will vary with each operation. Cost of gain increased with increasing sorghum test weight. Cost averaged \$.018 and \$.043 more per lb of gain for the steers consuming 35 lb sorghum compared with 45 lb and 55 lb sorghum, respectively. Averaged across test weight within a feeding level, limit-feeding cost \$.0092 more per lb of gain compared with full-feeding level. Light test weight grain sorghum (35 and 45 lb/bu) was superior to or comparable to normal sorghum (55 lb/bu) in feeding value when fed dry rolled in a limit-fed, high concentrate or full-fed, high roughage, growing diet for yearling beef steers.

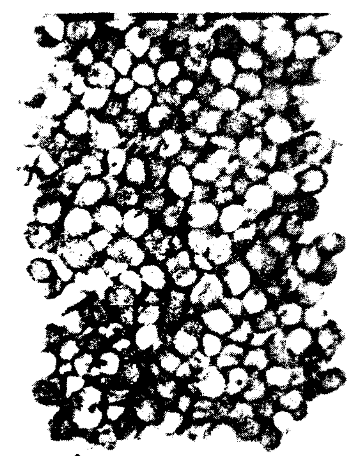
Table 6. Cumulative feed to gain ratio and cost of gain of steers during growing phase.

	Limit-Fed			Full-Fed			
Item	HC35	HC45	HC55	HR35	HR45	HR55	SEM[a]
Day 0-28[b]	4.52d[e]	4.03[c]	4.71[e]	4.08[cd]	4.39[cde]	4.72[e]	.20
Day 0-56[fg]	5.44	5.27	5.59	5.46	5.70	6.08	.19
Day 0-84[i]	5.42	5.29	5.49	5.97	6.19	6.62	.23
Day 0-112[j]	6.21	6.20	6.43	6.79	6.95	7.53	.25
Cost of Gain, $/cwt	30.05	32.35	34.71	29.74	30.97	33.63	

[a] SEM = Standard error of the means, n=30 steers.
[b] Quadratic effect of test weight, P<.10.
[cde] Test weight main effect, P<.04.
[f] Test weight main effect, P<.1014.
[g] Linear effect of test weight, P<.06.
[h] Feeding level main effect, HC vs HR, P<.06.
[i] Feeding level main effect, HC vs HR, P<.0001.
[j] Feeding level main effect, HC vs HR, P<.0005.

35
CP = 13.3
ADF = 12.0
P= 0.42
Ca = 0.08

45
CP = 11.9
ADF = 7.0
P = 0.35
Ca = 0.04



55
CP = 11.4
ADF = 3.8
P = 0.33
Ca = 0.02

* The authors express sincere appreciation to the Kansas and Texas Grain Sorghum Commissions for funding of this project and to the Animal Caretakers and Ag Technician for their assistance in animal care and data collection.

EFFECTS OF FESCUE GRAZING PASTURE TREATMENT, ON FEEDLOT PERFORMANCE OF BEEF STEERS

by

A.S. Freeman, Ken P. Coffey, and Steve Clark

SUMMARY

Sixty-three crossbred steers (avg 740 lb) grazing endophyte-infected tall fescue were used to evaluate the effects of supplemental ground sorghum grain at .25% (GS25) or .5% (GS50) of full body weight compared to no GS (CON) on grazing and subsequent feedlot performance. Grazing ADG was .53, .81, and 1.21 lb for CON, GS25, and GS50 treatments, respectively. Pasture supplementation did not affect (P>.10) feedlot dry matter intake or ADG. Compensatory gain was exhibited by CON steers compared with GS50 steers. Steers receiving the GS25 treatment were 2.3% and 6.2% more efficient (P<.07) during the feedlot phase than CON and GS50 steers, respectively. The GS50 steers were 3.8% less efficient (P<.07) than the CON steers. Combined ADG was not affected (P>.10) by pasture treatments. Pasture supplementation increased (P<.075) adjusted backfat by .09 in. and decreased (P<.022) yield grade by .45 percentage units. Other carcass characteristics were not affected (P>.10) by pasture treatments. Supplementing steers grazing endophyte-infected fescue at a rate of .25% of body weight with ground sorghum grain improved feedlot feed conversion, decreased cost per cwt gain, and improved yield grade.

INTRODUCTION

Kansas received approximately 3.346 million cattle in 1990; 43% of these animals arrived in southwestern Kansas. Between 20 to 25% of these animals could have originated from eastern states where fescue is a major forage used in grazing systems. Fescue plants and seeds have shown infection rates with the endophytic fungus Acremonium coenophialum from zero to near 90%.

Cattle grazing highly endophyte-infected fescue have shown signs of fescue toxicosis or 'summer slump'. These feeder cattle are often discounted for their poor appearance and pasture performance when they reach western feedlots. Various management practices have been applied to eradicate or reduce the toxic effects of the infected fescue. One possible practice is to provide supplemental or substitutive energy in the form of a cereal grain to grazing cattle to dilute the toxins produced by the fungus. This study was designed to investigate the effects of supplemental ground grain sorghum fed to beef steers grazing endophyte-infected fescue on their subsequent feedlot performance.

EXPERIMENTAL PROCEDURES

Sixty-three crossbred steers grazing endophyte-infected tall fescue were used to evaluate the effects of supplementation with two different levels of ground sorghum grain on pasture and subsequent feedlot performance. The trial consisted of a 62-d grazing phase at the Southeast Kansas Branch Experiment Station, Parson, KS and a 132-d finishing phase at the Southwest Kansas Research-Extension Center, Garden City, KS.

Grazing Phase. Ninety steers, which had previously been vaccinated against IBR-, PI_3-BVD, five strains of leptosporoiea and given a 7-way clostridial injection, were co-mingled for 7 days on a endophyte-free fescue, bromegrass, and native grass pasture. Initial full weights were measured on May 8 and 9. Steers were also vaccinated against pinkeye and BRSV, dewormed with levamisole, received an insecticide ear tag to control flies, and were randomly allotted by weight into nine lots of seven head each.

Steers were then transported to one of the nine five-acre tall fescue pastures, and three groups of 21 were offered either .25% (GD25) or .5% (GS50) of full body weight as ground grain sorghum per head daily or received no supplement (CON). The remaining 27 head were used as needed to control excess forage production on the experimental pastures.

The pastures were grazed for 56 d from May 9 until July 3 using a put-and-take grazing system to ensure uniform forage availability across pastures. These pastures had previously been grazed by fall-calving cows until early April. Water and mineral blocks containing monensin were provided free-choice.

Interim weights were measured on May 29 and June 20, and grain levels were adjusted accordingly. The cattle were weighed on the morning of July 3 and moved to the previously grazed, 45-acre, mixed grass pasture for 7 days to equalize gut fill. Final full pasture weights were measured on July 9 and 10, and the cattle were moved to a local stockyard and fed prairie hay during the day. That evening to reduce heat stress, all 90 steers were transported to the Southwest Kansas Research-Extension Center, Garden City, KS for the feedlot phase of the trial.

Feedlot Phase. Cattle arrived at the SWKRE Center by 5:30 a.m. on July 11 and were individually weighed off the truck, then Tiguvon® (Fenthion) was poured on them. Steers were divided into groups of 10 head and placed in feedlot pens with fresh brome-grass hay and water overnight. On July 12, the second initial weight was obtained and all 90 steers were implanted with Compudose200® implants. Steers were also sorted into groups of seven head per pen to maintain grazing phase treatment structure. The additional 27 steers were sorted into four pens by weight.

All steers received a starter ration on July 12 and were brought up to full feed (Table 1) during a 13-day period. On July 24, cattle were re-vaccinated against IBR-BVD-PI_3, and 5 strains of leptospira and dewormed with Valbazen® (Albendazole). Deccox® (Decoquinate) was fed at a rate of 180 mg per head per day for 33 days then removed from the ration. Cattle were then fed Rumensin® (Monensin) and Tylan40® (Tylosin) at 150 and 90 mg per head daily for 7 days. Monensin was then increased to 300 mg for the remaining feedlot period.

Interim individual weights were taken on Sept. 13 and Oct. 25 and final weights on Nov. 19 and 20. Feedlot performance data consisted of daily dry matter intake, average daily gain, and feed-to-gain ratio for both weigh periods and cumulative days on feed. Only overall feedlot performance will be presented, not interim performance. Carcass characteristics were obtained after a 24-hr chill.

RESULTS AND DISCUSSION

Grazing Phase. Approximately 70% of the fescue plants in the experimental pastures were infected with the endophytic fungus *Acremonium coenophialum*. The 63 steers averaged 740 lb when placed on pasture. Steers receiving no supplemental grain (CON) gained 33 lbs during the 62-d grazing phase for an ADG of .53 lb (Table 2.). The GS25 steers gained an additional .28 lb per d, giving a total gain of 50 lb per head. Steers consuming GS50 had an ADG of 1.21 lb, resulting in an additional 42 lb of gain compared with the CON group. Pasture grain consumption was 105 and 215 lb for the GS25 and GS50 treatments, respectively.

Table 1. Ingredient composition and nutrient analysis of starter and finisher rations.

Item	Starter	Finisher
	----- % -----	
High-Moisture Corn	9.5	
Dry-Rolled Corn	34.9	
Steam-Flaked Corn		74.8
Alfalfa Hay	44.4	7.6
Corn Silage	6.2	8.1
Molasses	2.6	2.2
Supplement	2.4	7.3
Cost per cwt, $[a]	3.79	3.83
Nutrients[b]		
Dry Matter	77.9	74.6
Crude Protein	14.3	12.6
NEm, Mcal/cwt	79	98
NEg, Mcal/cwt	51	67
Calcium	.92	.90
Phosphorus	.28	.37
Potassium	1.65	.93

[a] Based on $2.25/bu corn.
[b] Calculated values.

Feedlot Phase. Cattle experienced an average transit shrink of 7.4% (Table 2.). The CON steers lost 5% more live weight compared with the GS25 and GS50 groups. However, the CON and GS50 steers both gained 520 lb during the feedlot phase. This indicates a possible compensation for poorer pasture performance and transit live weight loss experienced by the CON steers. The GS25 steers gained 12 lb more (P>.10) compared with the other steers. Dry matter intake and ADG were not affected (P>.10) by pasture treatments. However, GS25 steers required 2.3% and 6.2% less feed (P<.07) during the feedlot phase per lb of gain compared to CON and GS50 steers. The GS50 steers were 3.8% less efficient (P<.07) in converting feed to live weight gain compared with the CON steers. Combined ADG was not affected (P>.10) by pasture treatments.

Carcass characteristics are given in Table 3. Hot carcass weight (avg 764 lb), rib-eye-area (avg 12.8 in.^{2}), KPH (avg 2.74%), marbling score (choice -), and dressing percent (avg 63.2%) were not affected (P>.10) by pasture treatments. Supplementation increased (P<.075) adjusted backfat by .09 in. and decreased (P<.022) yield grade by .45 percentage units.

Table 2. Pasture, feedlot, and combined performance of steers receiving ground sorghum grain supplements when grazing endophyte fungus infected tall fescue.

	Pasture Grain Level, % of BW		
Item	CON	GS25	GS50
Pasture Phase[a]			
Initial Wt.	743	738	740
Final Wt.	776	788	815
Pasture Gain	33	50	75
Daily Gain	.53	.81	1.21
Grain Consumption	0	105	215
Feedlot Phase[a]			
Initial Wt.	716	731	756
Final Wt.	1236	1263	1276
Feedlot Gain	520	532	520
Dry Matter Intake	22.6	22.6	23.5
Daily Gain	3.94	4.03	3.94
Feed to Gain	5.74[d]	5.61[b]	5.96[d]
Combined Total[e]			
Total Gain	553	582	595
Daily Gain	2.53	2.72	2.75
Concentrate Intake	20.5	21.04	22.43
Concentrate $/cwt Gain, $	27.67	27.09	28.35

[a] Pasture phase - 62 days; feedlot phase - 132 days.
[bcd] Treatment means are different, $P<.07$.
[e] Sorghum grain cost $4.45/cwt and finisher diet cost $76.52/ton. As fed basis for pasture grain and feedlot ration intake for 194 days.

Table 3. Carcass characteristics of steers receiving ground sorghum grain supplements when grazing endophyte fungus infected tall fescue.

	Pasture Grain Level, % of BW			
Item	CON	GS25	GS50	SE[a]
Hot Carcass Wt., lb	748	763	780	14.6
Rib Eye Area, in.^{2}	13.1	12.4	12.9	.24
Adjusted Backfat, in.	.39[b]	.47[c]	.49[c]	.029
KPH, %	2.7	2.8	2.8	.11
Marbling Score[d]	5.0	5.1	4.9	.14
Dressing Percent	62.9	62.8	63.6	.36
Yield Grade	2.7[e]	3.2[f]	3.1[f]	.13

[a] Standard error of means.
[bc] Treatment means are different, $P<.075$.
[d] Select = 4 to 4.9; choice minus = 5 to 5.9.
[ef] Treatment means are different, $P<.022$.

Cattle grazing endophytic fungus-infected tall fescue typically experience a decline in performance. Providing a supplement in the form of ground grain sorghum during grazing appears to enhance feedlot performance. In this trial, ground grain sorghum fed at .

25% of live body weight while cattle grazed endophyte infected fescue resulted in acceptable feedlot performance and carcass characteristics.

Southwest Research-Extension Center

DIRECT-FIRED STEAM GENERATION FOR PROCESSING GRAIN

by

AS. Freeman

Direct-fired steam generation is not a new process. Ever since a bowl of water was spilled directly into a fire, we have witnessed the immediate generation of steam. However, the application of this technology may not be so ancient.

This particular system has been used for curing concrete products; generating and providing instant hot water used in counter-flow heat exchange tanks; mash conditioning for pelletizing poultry feeds; and the most recent application, generation of steam for conditioning whole grains prior to steam flaking, crimping, or rolling. The VE Corporation, located in Arlington, Texas, has leased a vaporator and garner gate system with the option to buy to the SWKREC for the sole purpose of comparing this system of processing grains by steam-flaking to the conventional boiler steam generated process. Figure 1 below is a diagram of the vaporator, which generates a homogeneous mixture of steam and products of combustion. This steam mixture is then routed to a steam chest equipped with garner gates (figure 2). These two gates are analogous to a flour sifter and are positioned just above a transition zone above the rolls. The garner gates allow the grain within the chest to move evenly down the chest instead of coring. They also allow for a slight pressurization of the steam chest. Dr. Robert R. McEllhiney, professor of Grain Science and Industry at KSU, Manhattan, has written an article, A new era of steam generation?, in the April 1987 issue of Feed Management covering the VE System. This article and literature produced by VE Corp. will provide general information about the VE system.

Future studies at the SWKREC will compare the products of grain processing with both boiler and VE generated steam through growing and finishing trials. The availability of starch or degree of processing will be evaluated by chemically measuring glucose release in the lab and in the animal using the nylon bag technique. Grain conditioners applied before processing will be evaluated with both systems. Most importantly, cost of grain processing will be monitored throughout the active use-time of each system. We hope to be able to provide the information needed for making economical decisions concerning the use of boiler versus direct-fired steam generation in processing cereal grains for feedlot cattle.

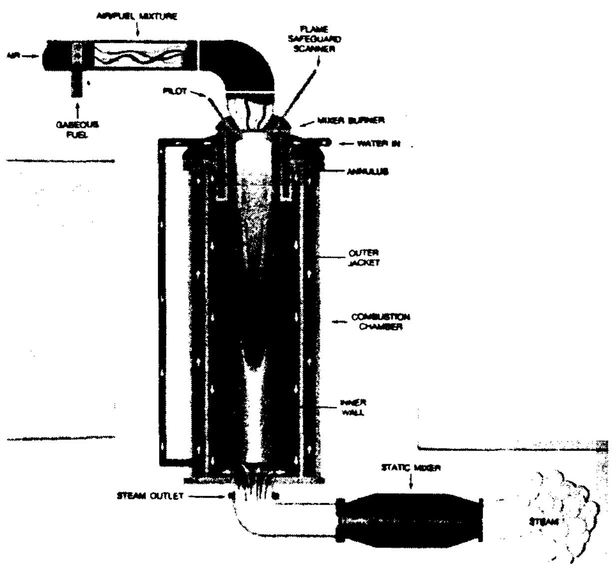


Figure 1

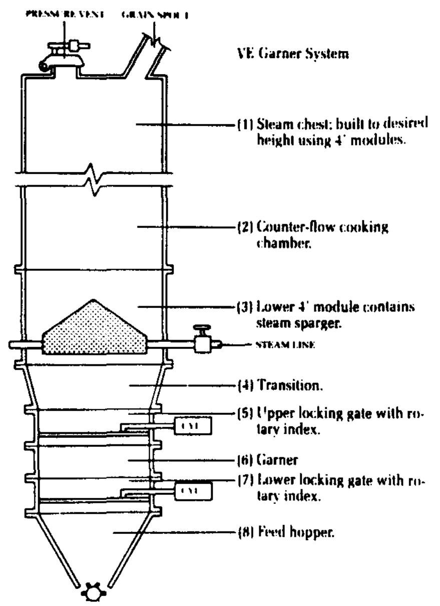


Figure 2

KSU Southwest Research-Extension Center

STABLE FLY RESEARCH IN CATTLE FEEDLOTS

by
Gerald Greene

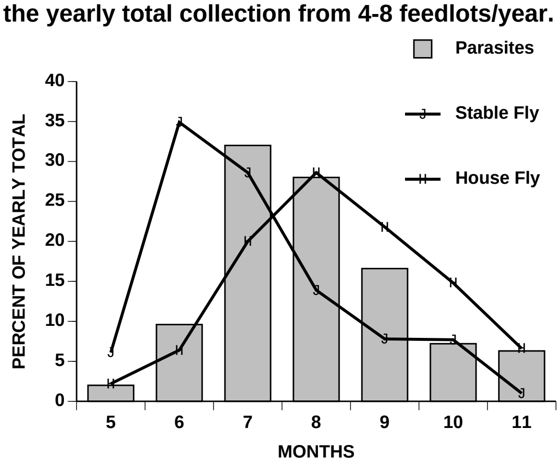
Stable flies irritate cattle in feedlots by their feeding habit. Adult flies attack cattle legs to secure blood meals necessary for them to mature and lay eggs. That feeding disturbs the cattle to the point of reducing weight gain and feed conversion efficiency. Studies on this cattle feedlot pest are being conducted to develop efficient and economical control methods.

Relative Populations of Flies in Cattle Feedlots

Two species of flies occur in Kansas cattle feedlots, house flies and stable flies. The stable fly, by taking blood meals, causes cattle to bunch together, stamp, switch their tails, and reduce feeding time. House flies cannot bite, because they have only sponging mouth parts and feed on free-standing liquids or solids that they can dissolve with saliva. The house fly is only a nuisance, where as the stable fly causes economic loss.

Typical seasonal cycles of fly populations in western Kansas are shown in Figure 1. Stable flies are abundant during the spring, then typically decline in number in conjunction with hot dry conditions during July. High stable fly populations may occur for 16 weeks in cool wet summer or during cool wet periods in late summer. House fly populations are low until July, reach peaks in August, then decline with dry, cool, fall conditions. They are numerous in early September, and are a real pest in vehicles when cool weather begins. They are attracted to the warmth in pickup cabs! House flies may be only a public relations problem.

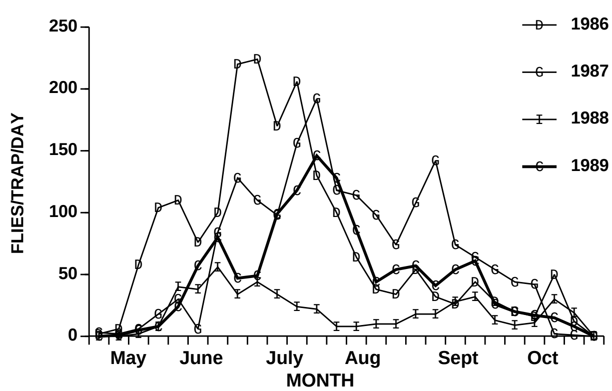
Figure 1. Fly and parasite occurence percent by month of the yearly total collection from 4-8 feedlots/year.



Natural populations of fly parasites in feedlots peak during July (bars, Figure 1) when the total fly numbers are highest, then decline. Winter mortality of parasites reduces the early spring populations. The delay in development of parasites in May and June leaves them ineffective on stable fly populations. Spring releases of commercially reared parasites may be a good method to improve control of stable flies, which are numerous during May and June.

Populations of stable flies in Kansas cattle feedlots during specific years can be seen in Figure 2. Even though the relatively wet conditions during 1989 provided adequate breeding material for stable flies, fly populations did not peak during June as in other years. The population peak on July 23 was not as high as those during 1986 and 1987. The September peak of 1987 was not present during 1989, even though rain was frequent in both years. There were considerably fewer stable flies in cattle feedlots during 1988, a relatively dry year.

Figure 2. Stable flies on Alsynite traps (average of 7 cattle feedlots without parasite releases).



Stable flies were abundant in most of the High Plains during 1989. Many reports of intense biting by stable flies were received. The loss of gain in some cattle feedlots was significant during 1989, whereas others incurred relatively little loss. Stable fly numbers during 1990 were quite variable from one feedlot to another, as was rainfall. Populations peaked in mid June and mid August, with lows during late July and September.

Natural and Commercial Fly Parasites

We have conducted several releases of commercially and laboratory-produced parasites in Kansas cattle feedlots. In only 2 of 12 cases have we recorded fly reductions or increased parasitism of fly pupae as a result of these releases. Three things that must be improved to obtain repeated success with parasite releases are:

1. use of parasite species adapted to Kansas conditions;
2. improved rate of parasite emergence from fly puparia;
3. reduced contamination of commercial cultures by less effective species of parasites.

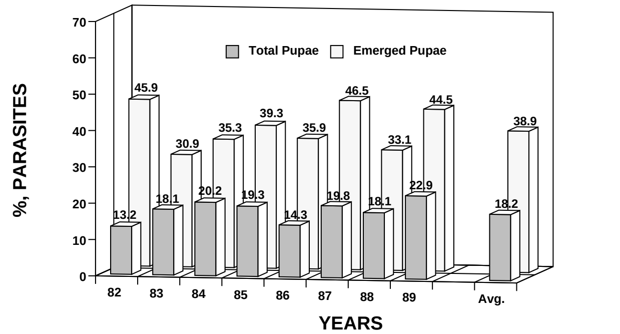
Parasites Adapted to Kansas Cattle Feedlots

The naturally occurring fly parasites in Kansas feedlots are different species than those being sold commercially. Samples from 25 feedlots (6 to 12 feedlots/year) for 8 years have shown which parasites are present and the incidence at which they occur (Figure 3). Fly pupae produce an average of 38.9% live parasites, and additional fly pupae are killed by parasites that do not produce a live parasite. With that percentage killed under natural conditions, it should be possible to hold fly numbers below damaging levels, if we could double the parasite-induced mortality to 78% with parasite releases of locally adapted parasites.

The two main groups of pupal parasites occurring naturally in Kansas cattle feedlots are Spalangia (49%) and Muscidifurax (51%). For the Spalangia genus, S. nigroaenea (75%) dominates the natural populations. The S. cameroni (25%) populations never contributed over 30% of a sample but were always present in the feedlots. The Muscidifurax consisted of two species, M. raptor and M. zaraptor, which are difficult to distinguish. M. raptor was approximately 21% and M. zaraptor 79% of the Muscidifurax emerging from fly puparia.

Muscidifurax zaraptor were predominantly (92%) from house fly pupae, compared to 8% from stable fly pupae. This parasite might be the choice species for house fly control. Because among the major commercial parasites sold (it is easy to rear),

Figure 3. Occurrance of natural fly parasites from fly pupae in four to eight feedlots/year.



the control of house fly pupae is probably greater than the control of stable fly pupae where commercial parasites are being released. Even so, some of the highest house fly populations have been seen in cattle feedlots where M. zaraptor were being released. Possibly the numbers of parasites released were too low or the release method inadequate to control house fly populations. The appropriate parasite species for stable fly control appears to be S. nigroaenea rather than M. zaraptor, which attacks few stable fly pupae.

S. endius and Nasonia vitripennis have been sold and released in feedlots but seldom retrieved from fly pupae. This demonstrates that these species have not established in our feedlot environment and probably are not adapted to the conditions present. Supplying a mix of parasite species is like putting water and gas on a fire, hoping one will work. You really need to know what species will control flies before spending money for parasites.

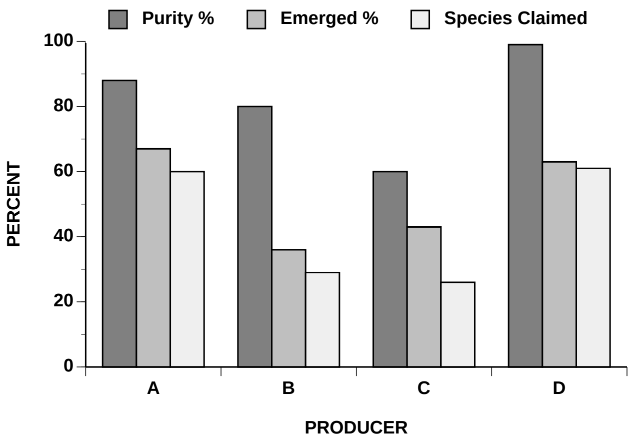
Parasite Emergence

Commercially sold fly parasites arrive at the feedlot in the form of parasitized house fly pupae. Parasite emergence from pupae must occur if releases are to effectively reduce fly numbers. Emergence has never been high, averaging 50 to 60% from the best material we have released (Figure 4). The best emergence for an entire season (20 to 26 weekly releases) was 57% in 1987. The poorest emergence for an entire season was 36% in lot C in 1986. Emergence ranged between 10 and 80% for weekly samples, resulting in a season average of about 55% for lot A.

Contamination

Only the desired species of parasites should emerge from parasitized fly pupae delivered to the feedlot. Too often, less than 80% of the emerging parasites are species adapted to Kansas cattle feedlots (lots B & C, Figure 4). For lot D (1989 release of S. nigroaenea produced in our laboratory), the pu-

Figure 4. Insectary parasite purity = of claimed parasites, emerged % = total pupae emerged, species = % of fly pupae.



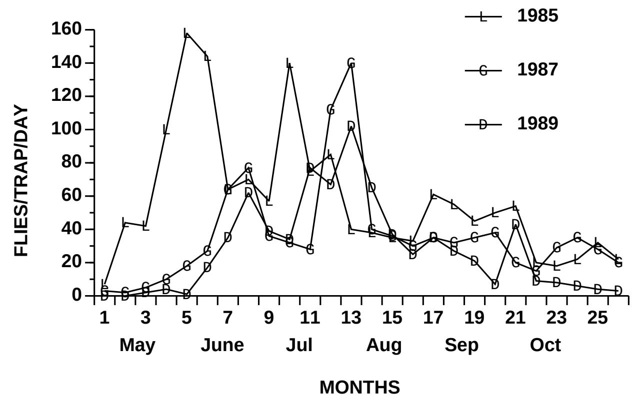
rity was good, with only two parasites out of 585,000 being contaminants. Contaminants of commercial parasites are often S. endius or Nasonia vitripennis, neither of which reproduce in our feedlot conditions. Commercial insectaries rearing several species of parasites have difficulty rearing pure fly parasite colonies, and the parasite species adapted to cattle feedlots are the least competitive in the commercial parasite colonies.

For most parasite species, a live parasite will be produced in 50 to 60% of the fly pupae exposed to ovipositing females. This means that even with the best rearing conditions, the buyer will receive half as many parasites as fly pupae delivered. When you price parasites, you should make sure the quotation is for live parasites not fly pupae, which may or may not produce a live parasite. If we consider that males constitute 30 to 40% of the live parasites, it is apparent that only 35 of each 100 pupae received provide a potential fly pupal killer (live female parasite). Fortunately, that 35% will prevent numerous flies from emerging. Each female parasite will kill 15 to 50 flies and produce 15 to 45 second generation parasites.

Production and Release of Fly Parasites

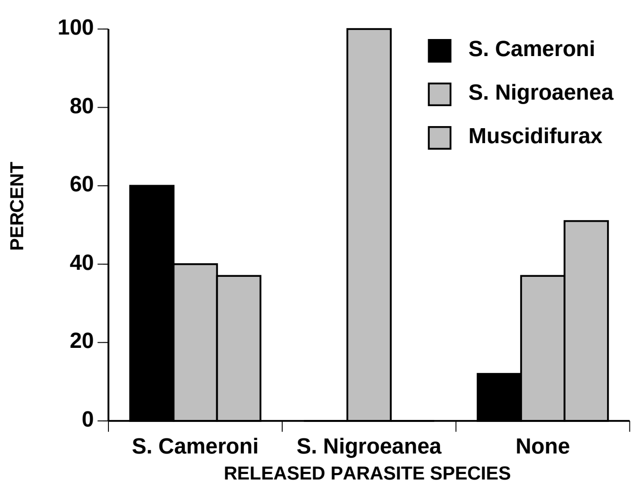
The best parasite species to use for stable fly control in Southwest Kansas cattle feedlots is S. nigroaenea. We have developed rearing methods in our laboratory to produce this parasite species for release, when others have been unable to produce this parasite. Releases of S. nigroaenea have been made during 1987 and 1989. The feedlot used has had considerably fewer stable flies present than during a similar non-parasite release year, 1985 (Figure 5). The stable fly populations caught on sticky traps were lower and peaked later in the summer during S. nigroaenea release years than during a non-release year, 1985. Special stable fly traps are set up at the feedlot to monitor fly numbers and, hence, to evaluate the effect of attempted biological control. The total number of flies caught was much lower during the release years of 1987 and 1989, and fly feeding on both cattle and people near the feedlot was reduced. The fall increase during September was lower than during 1985. Both years were environmentally similar to 1985 in rainfall received.

Figure 5. *Splangia nigroaenea* releases in similar rainfall years. 1985 no parasite; 1987 & 1989 *S. nigroaenea* released.



One key to measuring parasite release effectiveness is the recovery of parasitized pupae in samples collected from breeding sites in the feedlot (Figure 6). The proportion of S. nigroaenea increased in samples from the S. nigroaenea-release lot during 1989. The S. cameroni-release lot produced 61% S. cameroni and 39% S. nigroaenea from fly pupae collected, representing an increase in S. cameroni and a reduction in the proportion of S. nigroaenea. Stable fly numbers did not appear to be reduced on Alysnite traps.

Figure 6. Parasites from stable fly pupae from two release and one non-release feedlots during 1989.



The dominance of Muscidifurax in the S. cameroni -release lot resulted from Muscidifurax making up the majority of the parasite release material supplied by a commercial insectary and the superiority of the Muscidifurax over S. cameroni. In the S. nigroaenea -release lot, the dominance of that species over S. cameroni and Muscidifurax was obvious.

The retrieval of parasites from stable fly pupae where S. nigroaenea were released (Figure 6) is even more dramatic, when we look at the parasites retrieved from only stable fly pupae. S. nigroaenea was the only parasite species emerging from feedlot-collected stable fly pupae, and the total absence of S. cameroni and Muscidifurax was a big surprise. This had not been seen during previous parasite releases. S. nigroaenea had made up 73% of the parasites retrieved during 1987, but not 100% as during 1989. Greater numbers of parasites were released during 1989, which may relate to their dominance of the stable fly pupae. Muscidifurax were retrieved from house fly pupae in both years, demonstrating both that they were naturally present in the feedlots and that they are more effective against house flies.

The economic loss to cattle production from stable fly feeding was reported in Nebraska to be 0.2 lb./day when 4 or more flies per leg were observed on feeder cattle. Populations were above that level for 5 weeks during 1989 (Figure 7) and would have reduced gain by 7 lb./animal. If we multiply that by .70 cents/lb., the loss is nearly $5.00. Examples of other prices/lb. and "fly days" can be seen in Figure 7. The longer the fly season, the greater the loss. Stable fly numbers during 1985 were high for about 16 weeks, resulting in $12.00 to $16.00 loss per animal.

Figure 7. Costs of stable fly feeding calcutated at three prices at 1 to 9 weeks of fly feeding.

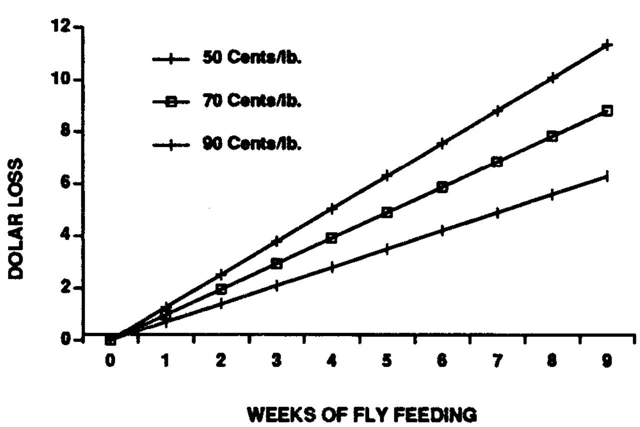
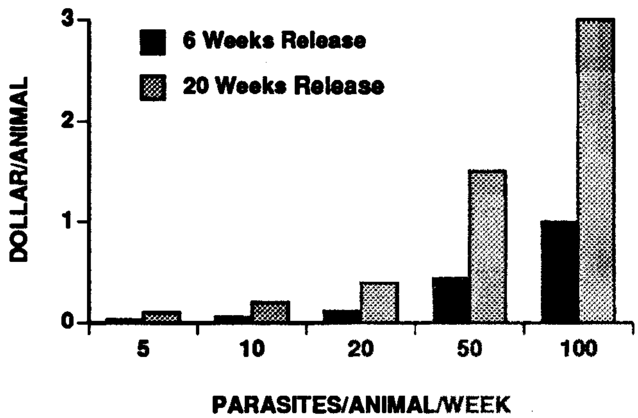


Figure 8. Costs of fly parasites at three rates of release and for three different time periods.



The costs for fly parasites are shown in Figure 8. Figures are based on the current costs and for different numbers of parasites released per week. Five parasites per animal per week was the level used for several years prior to the demonstration of parasite failure at that release level. Twenty parasites per animal per week is the level currently being used by some suppliers. Of more interest is the 50 per week level used during 1989 with S. nigroaenea releases, where only S. nigroaenea were retrieved from stable fly pupae. Comparing the animal production loss from fly feeding (Figure 7), it is obvious that an investment of $0.45 for 6 weeks of control would provide $6.00 return when cattle sell for $0.70 per pound, a $5.55 profit or $13.33 return for every dollar invested! Costs are under $0.50 per animal until over 50 parasites per animal or over 12 weeks of releases are used. Further work is needed to determine if even higher numbers of parasites per animal per week are needed to provide effective and economical stable fly control, what species or species combinations should be used, how often to release, and what are the best release methods or conditions under which releases should be made.

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Some of the research reported herein was conducted under special FDA clearances that apply only to investigational products used at approved research facilities. Materials and (or) feed additives that require FDA clearances may be used in the field only at the levels and for the uses specified in that clearance. Product feeding guidelines established by research trials and (or) taken from a current Feed Additive Compendium were typically used.

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