CATTLE FEEDERS' DAY 1996

Report of Progress
773

Agricultural Experiment Station
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EFFECTS OF ALFALFA HAY PARTICLE LENGTH ON STEER FEEDLOT PERFORMANCE, RUMINAL pH, RUMEN DIGESTA LOAD, AND CARCASS CHARACTERISTICS

by

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SUMMARY

Two hundred sixteen steers (766 lb) were fed a finishing diet containing high moisture corn and alfalfa hay for 135 days. The three experimental diets differed only in alfalfa hay particle length: nonprocessed, long-stem hay (coarse), ground through a 2.5 inch screen (medium), or ground through a 2.5 inch screen followed by regrinding through a .75 inch screen (fine). Numerically, steers fed the coarse hay gained 3.3 and 5.1% faster than steers fed fine and medium ground hays, respectively. Steers offered coarse hay diets were 3.4% more efficient than steers offered the fine hay diets and 7.1% more efficient (P<.05) than steers offered the medium hay diet. Carcass characteristics were not affected by hay particle length in the diet. Concurrent with the feeding trial, six ruminally cannulated steers were utilized in a replicated 3 x 3 Latin square design to measure rumen fermentation and fill characteristics. Hay particle length in the diet did not affect rumen pH, rumen digesta load, or percent dry matter of the rumen contents.

INTRODUCTION

The benefit derived from grinding forages, in terms of improved animal performance, is well documented for cattle consuming high roughage diets. This improvement in performance is attributed largely to an increase in voluntary feed intake. However, little is known regarding the most desirable particle length of forage, particularly alfalfa hay, when fed at low levels in finishing diets. Feedlots commonly tub-grind alfalfa hay to put it into a physical form that can be handled easily and provide a more uniform product for consumption. Wind loss, grinding time, and the cost of grinding are routine losses reluctantly accepted by feedlots utilizing hay in their finishing diets. In the past decade, the popularity of big round and big square bales has generated technology to aid in their handling, especially at feedout in range situations. Shredders, slicers, and cutters, in addition to feed boxes that have the capability to tear apart and deliver hay from large bales, now make it possible to deliver long hay directly to the feedbunk. If long hay were applicable in finishing diets, the same technology could be adapted at mill-side and eliminate the entire tub-grinding process.

PROCEDURES

This study was conducted from March 3 to August 10, 1996. It included 216 crossbred Charolais, Limousine, and Angus steers that were assigned randomly to one of three treatments. Each treatment was represented by eight pens each containing nine steers. The steers were fed in open lot pens with concrete flooring. There were 24 in of linear bunk space and 62 sq ft of pen area per animal. Initial weight was based on one weight (no shrink), and the final weight was based on carcass weight adjusted to a 62% dress. Cattle were implanted with Implus-S at the start and with Revalor on day 64 of the feeding period.

Cattle were stepped up to their final diet in 14 days using two step-up diets; 40.5 % grain, 40% corn silage, and 5% alfalfa hay in step 1 and 65.5% grain, 15% corn silage, and 5% alfalfa in step 2. The final diet contained 80.5% grain, 5% alfalfa hay, 4% beef tallow, 6.5% soybean meal, and 4% supplement. (Table 1). Cattle were fed once daily in the morning. The bunk was empty just before feeding on about 2 out of every 3 days.

One crop of alfalfa hay, baled commercially (large square, 4 ft x 4ft x 8 ft) was used as the

Table 1. Ingredient composition of the finishing diet (dry matter basis)[a]

Ingredient	% of diet dry matter
High moisture corn	80.5
Alfalfa hay	5
Beef tallow	4
Soybean meal	6.5
Urea	.89
Limestone	.97
Dical	.83
Potassium chloride	.448
Magnesium oxide	.28
Salt	.3
Zinc oxide	.02
Rumensin 80[b]	.017
Tylan 40[c]	.287
Vitamin E premix[d]	.015
Vitamin A&D premix[d]	.001
Trace mineral premix[e]	.02
Mineral oil[f]	.20

[a] Formulated to contain 14.0% CP, .8%K, .6% Ca, .4% P, and .25% Mg.
[b] Rumensin added at 30 g / ton of complete diet.
[c] Tylan added at 10 g / ton of complete diet.
[d] Vitamin A added at 2000 IU, vitamin D added at 200 IU, and vitamin E at 20 IU per lb of complete diet.
[e] Contained .05% Co, 3.69% Cu, 17.5% Fe, .19% I, 12.51% Mn, 6.66% S, and 14.98% Zn.
[f] Added to the mineral supplement for a binder.

roughage source. The diets were (1) fine-prepared by tub-grinding hay through a 2.5 in screen, then again through a °in screen; (2) medium - prepared by tub-grounding through a 2.5 in screen; and (3) coarse - prepared by disrupting the physical form of the bale with little reduction in hay particle length.

Following the feeding period, carcass data were collected, including incidence of liver abscesses, hot carcass weight, backfat thickness, and marbling score. Means were calculated for each pen, and data were analyzed using GLM procedures of SAS.

Six ruminally fistulated steers (1439 lb) were used in a replicated 3 x 3 Latin square design to obtain rumen fermentation characteristics and measures of rumen fill. The steers were each fed one of the three test diets ad libitum for an a 11-day adaptation period. Digesta collection and pH measurements started on d 12 at prefeeding (0), and again at 3, 6, 9, 12, and 24 hours postfeeding. Orts were collected following the adaptation period and prior to feeding on day 13. Rumen fluid was collected from each steer by pooling digesta subsamples from the dorsal sac and reticulum, then straining through four layers of cheesecloth. Rumen pH was read from a pH meter linked to a sample probe that was submerged in the fluid sample from each steer. At 3 hours postfeeding on day 13, the steer's entire rumen contents were removed, weighed, and subsampled, and placed back in the rumen. The subsamples were frozen and thawed at a later date, weighed, and dried in a forced-air oven (55ϒC) until periodic check weights were constant. Samples were removed from the oven, air-equilibrated, and weighed; then dry matter was calculated.

RESULTS AND DISCUSSION

Feedlot performance data are shown in Table 2. No significant treatment differences were observed in feed intake or final weight. However, steers offered the coarse diets gained faster (P<.10) than steers offered medium-ground hay diets. Steers consuming coarse hay diets converted feed 3.4% more efficiently (P<.10) than steers offered the fine hay diets and were 7.1% more efficient (P<.005) than steers offered diets containing medium-ground hay. Differences in growth performance cannot be attributed to changes in gut fill because final weights were based on carcass weight adjusted to a 62% dress. Also, the improved performance with cattle fed coarse hay occurred during the mid and latter portions of the feeding period (data not shown).

Table 2. Effects of alfalfa particle length on steer feedlot performance.

Item	Fine	Medium	Coarse	SE
No. pens	8	8	8	
Initial wt., lb	765	767	768	3.9
Final wt., lb	1246	1239	1264	7.9
Feed intake, lb	20.50	20.78	20.45	.27
Daily gain, lb[1]	3.56[ab]	3.50[a]	3.68[ab]	.06
Feed/gain[1]	5.76[b]	5.95[c]	5.57[a]	.08

[1] Means with different superscripts differ (P<.10).

Carcass characteristics are shown in Table 3. No significant differences occurred in dressing percentages, liver abscess scores, backfat thickness, or quality grade. Hot carcass weights, although not significantly different, reflected results of the steer gains in that the faster-gaining steers on the coarse

Table 3. Effects of alfalfa particle length on steer carcass characteristics.

Item	Fine	Medium	Coarse	SE
Hot carcass weight, lb	768	761	776	7.3
Dressing %	62.0	61.5	61.5	.1
Liver abscess score[1]	.28	.18	.17	.10
Backfat, in	.42	.42	.41	.02
Quality grade[2]	3.91	3.88	3.78	.09
% Choice	72	71	63	.06

[1] 0 = no liver abscess, 1 = 1 small abscess.
[2] 1= Standard, 2 = Select, 3 = Choice-, 4 = Choice°, 5 = Choice +.

Table 4. Rumen digesta load of fistulated steers.

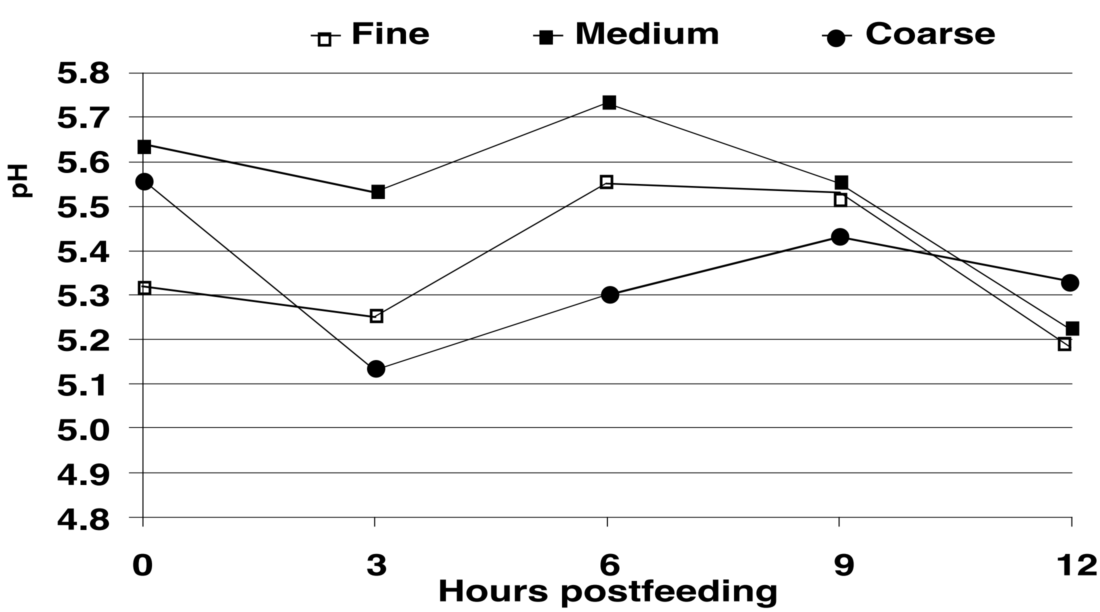
Item	Fine	Medium	Coarse	SE
Digesta wt., lb	132.6	135.6	135.2	5.4
Digesta dry matter, %	14.8	14.2	13.3	1.2
Digesta dry matter wt., lb	19.8	19.6	17.8	2.3

diet also had the heaviest hot carcass weights.

Changes in rumen pH over time are shown in Fig. 1. Rumen pH was different across sampling time but was not significantly (P>.10) affected by hay particle length. Rumen digesta load data are included in Table 4. Digesta weight, percent dry matter, and the weight of dry matter of digesta were similar for steers offered the three particle-length treatments.

Evidence from this experiment indicates a potential for improving steer feed conversion efficiency by feeding alfalfa hay in the long, unprocessed form.

Fig. 1. Effect of alfalfa particle length on rumen pH.



FACTORS AFFECTING THE OCCURRENCE OF DARK CUTTING BEEF AND SELECTED CARCASS TRAITS IN FINISHED BEEF CATTLE

by

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SUMMARY

A data set was generated to determine how various factors affect the occurrence of dark cutting beef and selected carcass traits in finished beef cattle. Data were collected in 1989 and 1990 from one packer with plants located in Amarillo, TX; Boise, ID; Dakota City, NE; and Garden City, KS. The data set consists of 3659 kill lots including 725,000 cattle. Compared to Boise, ID and Dakota City, NE, cattle slaughtered in Amarillo, TX, and Garden City, KS, had a higher incidence of dark cutters (1.1% vs .3%), had a lower quality grade (50 vs 64% choice plus prime), and had a higher dressing percent (64 vs 63%). The highest incidence of dark cutters occurred during August, September, and October (1.1 to 1.4%). This compares to .4 to .7% during the other months. During January, February, and March, carcass quality grade was 60 to 62% Choice plus Prime compared to the other months where it was 52 to 58% Choice plus Prime. As the number of cattle in a lot increased from less than 75 to over 300, the incidence of dark cutters increased from .4 to 1.2%, quality grade declined from 62 to 52% Choice plus Prime, and dressing percent increased from 63 to 64%. As the weight of cattle in the lot increased from less than 1000 pounds to over 1200 pounds, dark cutters declined from .94 to .6%, carcasses grading Choice plus Prime increased from 56 to 62%, carcasses of yield grade 2 declined from 51 to 43%, and dressing percent declined form 64 to 63%. If the cattle were in the pens at the slaughter plant 36 h or more before slaughter, the incidence of dark cutters increased from .8 to 1.6%. Other factors had minimal effect on carcass traits; including steers vs heifers, day of the week when cattle were slaughtered, kill shift, and chill time before carcasses were graded. We conclude that packing plant location, month of the year, weight of cattle, and number of cattle in a lot have an influence on the incidence of dark cutters and carcass quality traits.

INTRODUCTION

Dark cutting beef carcasses are discounted severely, and there is a perception that the incidence of dark cutting beef is increasing. Recently, we reported that, in over 8000 heifers at a commercial slaughter plant, 1.7% were dark cutters. Furthermore, the average fat thickness was 1.3 cm, and slightly more than 60% of the carcasses graded Choice or Prime.

The objective of this study was to generate a data set to determine how various factors affect the occurrence of dark cutting beef and selected carcass traits in finished beef cattle.

PROCEDURES

ABOUT THE CATTLE SLAUGHTER PLANTS

Data were collected from four plants. All plants were under the same ownership, and cattle slaughtered were grain fed. Plants were located in Boise, ID; Dakota City, NE; Garden City, KS; and Amarillo, TX. With the exception of holidays, the plants operated Monday through Friday and on alternate Saturdays. The plant at Boise, ID, conducted one 8-hour shift per working day, whereas the other three plants conducted two 8-hour shifts per work day. The first 8-hour shift operated from 0700 to 1530, and the second shift operated from 1600 to 0030.

DATA COLLECTION

Data were collected from January 1, 1989 to June 30, 1990 for plants located in Amarillo, Boise, and Dakota City. For Garden City, data were collected only during 1990. Data were collected from two lots of cattle per 8-hour kill shift, and each lot of cattle was an observation in the data set (Table 1). For Boise, which ran one kill shift per day, 574 lots of cattle (observations) were included in the data set and for the other three plants, the number ranged from 923 to 1103. The average number of animals per lot ranged from 146 head at Boise to 261 head at Amarillo. The average weight varied from 1103 to 1166. The data set included 3659 observations, made up of 724,639 head of cattle.

Table 1. Packing plant location, number of lots, number of cattle per lot, and weight of the cattle in a lot.

Item	Amarillo	Boise	Dakota City	Garden City
Number of lots in data set	1103	574	1059	923
Number of cattle in a lot				
mean	261	146	152	208
standard deviation	169	170	110	137
minimum	1	2	1	20
maximum	943	953	736	772
Weight of cattle in a lot				
mean	1100	1131	1166	1135
standard deviation	79	101	94	88
minimum	900	891	881	927
maximum	1385	1418	1500	1407

The person that collected the data followed a schedule (Table 2), so that the data would represent the entire 8-hour kill shift. Data were collected from lots killed during those hours of the 8-hour kill shift. For the next 8-hour kill shift, the schedule was advanced by one. After 28 kill shifts, the schedule started over.

The data set included only beef cattle; no Holsteins were included. The data that were recorded included: 1) slaughter day, (year, month, day); 2) kill shift (first or second of the day); 3) hour of the kill shift (one to eight); 4) carcass chill time (24, 48, 72, or 96h); 5) number of cattle in a lot; 6) weight of the cattle in the lot; 7) hot carcass weight; 8) sex (steer vs heifer); 9) carcass quality grade; 10) carcasses that were dark cutters; 11) carcass yield grade; and 12) whether or not the cattle were "carry cattle".

Carcass chill time is normally 24 h; that is, the carcasses are graded on the day after slaughter. When slaughter is interrupted by 1 day, chill time is 48 h, 2 consecutive days of no slaughter results in a 72 h chill time, and 3 days of no slaughter results in a 96 h chill time.

Table 2. Schedule of the hours within a kill shift when data were collected.

Kill shift	Hour collected
1	1,2
2	1,3
3	1,4
4	1,5
5	1,6
6	1,7
7	1,8
8	2,3
9	2,4
10	2,5
11	2,6
12	2,7
13	2,8
14	3,4
15	3,5
16	3,6
17	3,7
18	3,8
19	4,5
20	4,6
21	4,7
22	4,8
23	5,6
24	5,7
25	5,8
26	6,7
27	6,8
28	7,8

The number of cattle in a lot is the number of cattle in the group representing one purchase. Normally, this would represent one yard of cattle from one feedlot. Slight deviations from this generality might have occurred.

Weight of cattle in a lot represents the purchase weight of the cattle. This is determined by weighing the cattle at the feedyard at approximately 0700 and reducing that weight by 4%. If the cattle are weighed in the afternoon, body weight is reduced by 5%. If there are no scales at the feedyard, slight deviations from the described protocol are made.

Carcass quality grade was recorded to the nearest whole grade and grouped into three categories. First, carcasses grading either Choice or Prime; second, carcasses grading Select; and third, all others. These would include carcasses grading Standard and those of "C" or "D" maturity. Dark cutters are not included in this category.

"Carry cattle" refers to cattle at the slaughter plant that did not get slaughtered before a holiday or weekend. Although these cattle get slaughtered at the start of the next kill shift, 36 to 84 h may pass before they are slaughtered. This compares to the typical time of less than 12 h. If the lag is expected to be more than 36 h, the cattle are fed and water is available.

STATISTICAL ANALYSIS

From the data collected, the following were treated as response variables: percent dark cutters, percent Prime plus Choice, percent Select, percent other, percent yield grade 1, percent yield grade 2, percent yield grade 3, percent yield grade 4, percent yield grade 5, and dressing percent. Class variables included; year, month, day of week, packing plant location, year, kill shift, carcass chill time, lot size, lot weight, cattle sex, and carry cattle.

Data were analyzed using GLM procedures of SAS. A separate GLM procedure was conducted for each class variable. When the F statistic for the main effect was significant (P < .01), we listed the least significant difference (LSD) to be used for multiple mean comparison (P < .01).

RESULTS AND DISCUSSION

PACKING PLANT LOCATION

The incidence of dark cutters was greatest (P < .01) at Garden City but only slightly greater (1.24 vs .99) than that at Amarillo (Table 3). These two locations had three to four times greater (P < .01) incidence than either Boise or Dakota City.

Thirteen to fifteen percent more of the carcasses graded Choice plus Prime at Boise and Dakota City compared to Garden City and Amarillo (P < .01). The number of carcasses grading Select reciprocated the number of Choice and Prime. A greater percent of carcasses grading Select occurred at Amarillo and Garden City than Boise and Dakota City (P < .01). Carcasses in the "other" category accounted for only 1% of all the carcasses. This was expected, because the plants slaughter grain fed cattle.

Carcasses in the yield grade 1 category accounted for less than 10% of the total, whereas carcasses of yield grade 2 and 3 accounted for 30 to 50% each. The greatest percent of carcasses in the yield grade 1 category was at Garden City (P < .01), and the smallest incidence occurred at Boise (P < .01). The greatest percent of carcasses of yield grade 2 occurred at Amarillo (P < .01); it was 4 to 5% lower at Boise and Garden City and was lowest (P < .01) at Dakota City. Conversely, Dakota City had the greatest percent of yield grade 3 (P < .01) and numerically had the greatest percents of yield grades 4 and 5 as well.

Talling yield grades 1 and 2 shows 59.4% of the carcasses in these categories at Amarillo and Garden City, followed by 55% at Boise, and 47% at Dakota City. As one might expect, the number of carcasses grading Select (vs Choice and Prime) was much greater at Amarillo and Garden City. These differences might be related to differences in cattle type. Cattle at Garden City and Amarillo would have more *Bos indicus* and Corriente influence as compared to those at Dakota City or Boise. *Bos indicus* cross cattle have lower marbling scores compared to other crossbred cattle.

Dressing percent was highest at Amarillo (P < .01), and lowest at Dakota City (P < .01). Because cattle at Dakota City were the fattest (based on yield grade), one might have expected these to have the highest dressing percentage. Because the opposite occurred, other factors might have influenced dressing percent. One factor is likely cattle type. Brahman cross cattle have a higher dressing percent than other crossbred cattle. Another factor might be the differences in the diet fed to cattle. Finishing diets fed to cattle in the High Plains probably contain less dietary roughage, which equates to less ruminal fill,

Table 3. The effect of packing plant location on carcass traits of feedlot cattle.

	Packing plant location					
Item	Amarillo	Boise	Dakota City	Garden City	SE	LSD[a]
Dark cutters, %	.99	.28	.37	1.24	.06	.21
Quality grade, %						
Choice+Prime	49.8	63.3	65.2	52.9	.7	2.0
Select	48.0	34.4	33.1	45.0	.5	2.0
Other	1.1	2.0	1.2	.6	.2	.5
Yield grade, %						
1	7.1	6.1	7.4	13.2	.2	.9
2	52.3	48.8	39.4	46.3	.4	1.6
3	37.0	40.2	48.0	37.1	.5	1.7
4	3.4	4.6	4.9	3.2	.2	.6
5	.1	.2	.3	.1	.1	.1
Dressing %	64.2	63.0	62.8	63.8	.1	.1

[a] Least significant difference to be used to determine if means within are significantly different from each other. (P < .01).

which, in turn, would increase dressing percent. Generally, the grain fed to cattle in the High Plains is processed more extensively as well. If this results in less gut fill, it also would partially explain increased dressing percent.

EFFECT OF MONTH

The incidence of dark cutters was .56% during the first 3 months of the year, then increased slightly to between .7 and .9% from April through July (Table 4). From July to August, an increase from .9 to 1.4% occurred (P < .01). This level held through October, then incidence declined (P < .01) in November and was numerically lowest during December.

The percent of carcasses grading Choice plus Prime was greater than 60% in January, February, and March. From March to April, they declined (P < .01) by 5% and continued a slight numerical decline through September before increasing again in October, November, and December. The percentage of carcasses grading Select was a reciprocal of those grading Choice and Prime, with the greater percentage occurring from May to November. The percentage of carcasses in the "other" category ranged from .6 to 1.8%.

Although month had a significant effect on yield grade, no seasonal trends per se were apparent. The same applies to dressing percent.

Table 4. The effect of month of the year when cattle were slaughtered on carcass traits of feedlot cattle.

	Month[a]													
Item	1	2	3	4	5	6	7	8	9	10	11	12	SE	LSD[b]
Dark cutters, %	.56	.51	.62	.71	.84	.70	.90	1.43	1.13	1.40	.69	.43	.11	.38
Quality grade, %														
Choice+prime	60.8	62.1	62.0	57.1	54.8	55.0	53.4	52.8	52.0	55.0	55.2	57.8	1.1	3.7
Select	37.3	36.3	35.6	40.6	43.5	43.2	44.7	44.0	45.9	42.9	43.1	40.4	1.1	3.7
Other	1.3	1.0	1.6	1.5	.9	1.1	.9	1.8	.9	.6	.9	1.1	.3	NS[c]
Yield grade, %														
1	6.4	6.9	8.1	9.9	10.6	8.8	6.6	8.2	9.5	8.8	10.0	9.2	.5	1.6
2	46.6	47.3	49.4	48.0	48.7	46.9	45.1	44.4	41.1	42.8	44.2	45.1	.7	2.9
3	42.6	41.6	38.9	38.5	37.7	40.2	43.3	41.8	43.5	43.3	41.3	41.3	.8	3.1
4	4.2	4.0	3.5	3.5	2.9	3.8	4.7	5.4	5.5	4.8	4.1	4.1	.3	1.0
5	.2	.2	.1	.1	.1	.2	.2	.3	.3	.3	.3	.3	.1	.2
Dressing %	63.4	63.4	63.4	63.4	63.3	63.5	64.0	64.0	63.8	63.7	63.3	63.3	.1	.1

[a] 1 = January, 2 = February, 3 = March, etc.
[b] Least significant difference to be used to determine if means within a row are significantly different from each other (P < .01).
[c] If the main effect was not significant (P > .01), an LSD is not reported.

KILL SHIFT

Kill shift had no effect on percent dark cutters, but cattle slaughtered during the AM shift had 5% more carcasses grading Choice plus Prime (P < .01) than cattle slaughtered during the PM shift (Table 5). Part of the reason is that the slaughter operation at Boise included only an AM shift and cattle slaughtered there were higher grading than those at two other plants (Table 3). The effects of kill shift on yield grade were small.

Table 5. The effect of kill shift on carcass traits of feedlot cattle.

Item	Kill shift[a] AM	PM	SE	Prob > F
Dark cutters, %	.71	.83	.04	.06
Quality grade, %				
Choice+Prime	59.3	54.2	.4	.01
Select	38.7	43.9	.4	.01
Other	1.3	1.0	.1	.08
Yield grade, %				
1	8.0	9.4	.2	.01
2	46.5	46.6	.3	.86
3	41.2	40.0	.3	.02
4	4.1	3.8	.1	.03
5	.2	.2	.1	.71
Dressing %	63.5	63.5	.1	.71

[a] The AM shift occurred from 0700 to 1530, and the PM shift occurred from 1600 to 0030.

CARCASS CHILL TIME

The effect of chill time was not significant for percent dark cutters (Table 6). Chill time of 24 or 48 h had no effect on percent of carcasses grading Choice plus Prime, but carcasses chilled 72 or 96 h before grading had 3 to 5% more (P < .01) in the Choice plus Prime category. As one might expect, chill time had no consistent effect on dressing percent because it is determined by hot carcass weight.

NUMBER OF CATTLE IN A LOT

The number of cattle in a lot is a continuous variable, and it ranged from 1 to 953. For data analysis, we arbitrarily divided this into four categories; less than 75, 75 to 149, 150 to 299, and greater than 299. As the number of cattle in a lot increased, so did the incidence of dark cutters (P < .01; Table 7).

Table 6. The effect of chill time on carcass traits of feedlot cattle.

Item	Chill time 24	48	72	96	SE	LSD[a]
Dark cutters, %	.77	.86	.65	.54	.08	NS
Quality grade, %						
Choice+Prime	56.9	55.7	59.3	61.7	.9	2.2
Select	40.9	42.8	39.0	36.6	.9	2.1
Other	1.3	.6	1.0	1.2	.2	.5
Yield grade, %						
1	.7	8.2	8.8	6.3	.4	1.0
2	46.2	47.1	47.9	45.0	.7	NS
3	40.8	40.6	39.5	44.4	.8	1.8
4	4.1	3.9	3.5	3.9	.3	NS
5	.2	.2	.1	.2	.1	NS
Dressing %	63.4	63.6	63.4	63.5	.1	.1

[a] If the main effect was not significant (NS; P > .01), an LSD was not reported.
[b] Least significant difference to be used to determine if means within a row are significantly different from each other (P < .01).

Table 7. The effect of the number of cattle in a lot on carcass traits of feedlot cattle.

Item	Number of cattle in lot <75	75-149	150-299	>299	SE	LSD[a]
Dark cutters, %	.43	.64	.81	1.18	.06	.2
Quality grade, %						
Choice+Prime	62.5	59.1	55.4	52.3	.6	2.1
Select	34.1	39.3	43.2	45.9	.6	2.1
Other	2.9	1.0	.6	.5	.1	.5
Yield grade, %						
1	7.6	8.9	9.0	8.4	.3	1.0
2	46.5	45.3	46.8	47.7	.4	1.7
3	41.2	41.3	40.3	40.0	.5	NS[b]
4	4.4	4.2	3.7	3.7	.2	.6
5	.3	.2	.1	.1	.1	NS
Dressing %	62.9	63.5	63.6	63.9	.1	.1

[a] Least significant difference to be used to determine if means within a row are significantly different from each other (P < .01).
[b] If the main effect was not significant (NS; P > .01), an LSD was not reported.

The increased incidence of dark cutters with greater lot size could be attributed in part to packing plant location. The average number of cattle per lot was greater than 200 at Amarillo and Garden City compared to 150 at Boise and Dakota City (Table 1), and, Amarillo and Garden City had a greater incidence of dark cutters (Table 3).

If increased lot size is associated with greater physical activity when cattle are exposed to the new environment of the slaughter plant, this may have increased percent dark cutters. Also, the larger lot size could have been the result of mixing two or more pens of cattle from the same feedlot. If this occurred, one might expect more physical activity by the cattle when they were mixed and put in the new environment in the pens at the slaughter plant.

With increased lot size, a decrease (P < .01) occurred in the percent of carcasses grading Choice plus Prime and an increase (P < .01) in the percent grading Select. The effects of number of cattle in the lot on yield grade were small.

CATTLE WEIGHT

Cattle weight, a continuous variable, was grouped arbitrarily into four categories for data analysis: less than 1000 pounds, 1000 to 1099, 1100 to 1199, and greater than 1199 pounds. With increased cattle weight, incidence of dark cutters decreased (P < .01), and percentage of cattle grading Choice plus Prime increased (P < .01; Table 8). Increased cattle weight resulted in a decrease in the percentage of carcasses in the yield grade 2 category and an increase in the yield grade 3 category (P < .01), indicating that heavier cattle were fatter. However, dressing percent declined, which is the opposite of what we expected. We have no explanation of why lighter weight cattle had more dark cutters, or why those cattle were leaner with a higher dressing percent.

Table 8. The effect of cattle weight on carcass traits of feedlot cattle.

Item	Cattle weight <1000	1000-1099	1100-1199	>1199	SE	LSD[a]
Dark cutters, %	.94	.89	.75	.57	.07	.22
Quality grade, %						
Choice+Prime	55.8	55.	56.5	61.6	.7	2.2
Select	42.2	43.0	41.5	36.5	.7	2.1
Other	1.0	1.0	1.2	1.3	.2	NS[b]
Yield grade, %						
1	9.9	8.9	8.4	8.0	.3	1.0
2	51.4	48.2	46.6	42.6	.6	1.7
3	35.6	39.2	41.1	43.6	.5	1.8
4	2.9	3.5	3.7	5.4	.2	.6
5	.1	.1	.1	.3	.1	.1
Dressing %	63.8	63.7	63.5	63.0	.1	.1

[a]Least significant difference to be used to determine if means within a row are significantly different from each other(P < .01).

[b] If the main effect was not significant (NS; P > .01), an LSD was not reported.

HEIFERS VS STEERS

The main difference to note is that heifers were higher grading than steers (P < .01; Table 9).

Table 9. Differences in carcass traits of feedlot heifers vs steers.

Item	Heifers	Steers	SE	Prob > F
Dark cutters, %	.80	.74	.04	.32
Quality grade, %				
Choice+Prime	60.1	55.9	.4	.01
Select	36.3	42.9	.4	.01
Other	2.8	.4	.1	.01
Yield grade, %				
1	9.1	8.3	.2	.01
2	44.3	47.5	.3	.01
3	41.8	40.2	.3	.01
4	4.6	3.7	.1	.01
5	.2	.2	.1	.45
Dressing %	63.4	63.5	.1	.10

CARRY CATTLE

Carry cattle had a higher percent dark cutters than other cattle (P < .01; Table 10). We expected carry cattle to have a much higher incidence of dark cutters. Apparently, the stress effects that could cause dark cutters in carry cattle are not large.

OTHER FACTORS

Two other variables were analyzed; day of week and hour within a kill shift. No differences were attributed to hour within the kill shift when cattle were slaughtered. Effects of day of week on carcass traits were small and probably the results of carcass chill time. Cattle slaughtered on Friday or Saturday had carcasses that tended to have a higher percent in the Choice plus Prime quality grade (data not shown).

A few observations in the data set showed that greater than 10% of the carcasses in the lot were dark cutters, If these observations are removed from the

Table 10. Differences in carcass traits of feedlot carry cattle.

Item	Carry cattle no	Carry cattle yes	SE	Prob > F
Dark cutters, %	.77	1.64	.08	.01
Quality grade, %				
Choice+Prime	55.6	52.7	.8	.02
Select	42.7	44.7	.8	.10
Other	.9	.9	.1	.97
Yield grade, %				
1	10.0	9.9	.4	.88
2	46.9	47.0	.6	.86
3	39.5	39.6	.7	.96
4	3.5	3.3	.1	.68
5	.1	.1	.1	.92
Dressing %	63.5	63.7	.1	.01

data set, the overall incidence of dark cutters is reduced by only one tenth of one percent. Therefore, the overall incidence of dark cutters is not influenced to a large extent by lots of cattle with a high incidence.

EFFECTS OF FEEDING COMBINATIONS OF STEAM-FLAKED SORGHUM AND HIGH-MOISTURE CORN OR DRY-ROLLED CORN ON FINISHING STEER PERFORMANCE AND CARCASS CHARACTERISTICS

by

G. Lance Huck, Kelly K. Kreikemeier, Gerry L. Kuhl, and Keith K. Bolsen

SUMMARY

Three hundred six steers were blocked by weight and assigned to 30 pens. Following a step-up period, the steers were offered a 90% concentrate, 10% roughage diet for an average of 137 days. The diets differed only in grain type or grain combination and included the following treatments: dry-rolled corn, high-moisture corn, steam-flaked corn, steam-flaked grain sorghum, 2/3 steam-flaked grain sorghum:1/3 dry rolled corn, and 2/3 steam-flaked grain sorghum:1/3 high moisture corn. The grains were flaked to a 26 lb per bushel density, and flakes contained 19-20% moisture. Moisture level of the high-moisture corn was 35%. Numerically, daily gains were highest for cattle offered diets containing steam-flaked grain. Offering combinations of steam-flaked sorghum and dry-rolled or high-moisture corn improved gain and efficiency compared to feeding each grain type by itself. Steers offered the grain combination diets had gains and efficiencies similar to those of steers fed steam-flaked corn diets. No differences in backfat or quality grade were due to diet type.

INTRODUCTION

Grain sorghum and corn represent the major feed grains used in feedlots in the High Plains. Because of its starch-protein interaction, sorghum grain is digested less extensively than corn grain. Previous research has shown that the feeding value of sorghum grain is improved most when it is processed extensively, reconstituted, or harvested early and ensiled. Research also has shown that the feeding value of steam-flaked sorghum grain can range from 95% to 100% of the value of steam-flaked corn.

The feeding value of sorghum grain also can be improved by feeding grain mixtures. Previous research has shown that positive associative effects can occur when two grains are fed in combination in cattle finishing rations. However, the response to feeding grain mixtures apparently is affected by grain type and processing method.

Until last year at this center, no studies had been done to determine the feeding value of grain mixtures containing steam-flaked sorghum. The first study showed that positive associative effects on feedlot performance were achieved by feeding combinations of steam-flaked grain sorghum and steam-flaked corn. As a continuance, this study examined the effects of feeding steam-flaked grain sorghum and corn combinations, but dry-rolled or high-moisture corn was offered in place of steam-flaked corn. The reasons for choosing these two processing methods were: 1) they are popular corn processing methods in southwest Kansas and 2) they don't use valuable steam-flaker time required for processing grain sorghum.

PROCEDURES

Three hundred six predominantly Charolais-cross steers (760 lb) were blocked by weight and assigned to 30 pens. Steers in the heavy block were allotted randomly to 12 pens (12 hd/pen), and steers in the light block were assigned randomly to 18 pens (9hd/pen). Six experimental diets were fed to the steers for an average of 137 days. The diets were: 1) dry-rolled corn (DRC); 2) high-moisture corn (HMC); 3) steam-flaked corn (SFC); 4) steam-flaked grain sorghum (SFGS); 5) 2/3 SFGS:1/3 DRC; 6) 2/3 SFGS:1/3 HMC. Cattle were stepped up to their final diet in 14 days using two step-up diets. Step 1 contained 50% corn silage and step 2 contained 25% corn silage (dry matter basis). The final diet (Table 1) contained 10% corn silage, 74.5% grain, 4% beef tallow, 7.5% soybean meal, and 4% supplement (Table 2). Diets were balanced to contain 14.1% CP (11.6% with natural protein, 2.5% with urea). Cattle were fed once daily in the morning. Bunks were managed so that the steers would clean the bunk on 2 out of every 3 days. The steers were implanted with Synovex-S intially and with Revalor on day 49 of the feeding period.

Steam-flaked grains were flaked to 26 lb per bushel. Retention time in the chest was about 20 minutes, temperature just above the rolls was 210°F, and moisture of the fresh flake was 19 to 20%.

Steers in the heavy and light blocks were fed for 132 and 145 days, respectively. At the end of the feeding period, carcass data were recorded, including hot carcass weight, backfat, marbling score, and incidence of liver abscesses. Means were calculated for each pen, and data were analyzed using GLM procedures of SAS. To analyze the data as a randomized complete block design, the model included block and treatment.

RESULTS AND DISCUSSION

Feedlot performance is shown in Table 3. Average starting weight for the steers was 766 lb. Daily gains and final weights were numerically highest for steers offered diets containing steam-flaked grain, regardless of grain type. Dry matter intakes did not differ (P>.05) among treatments. Steers tended to be least efficient when offered DRC and most efficient if offered SFC or the SFGS/HMC combination.

Perhaps the most interesting interpretations of the data are shown in Figures 1 and 2. Both figures show the positive associative effects for daily gain and feed efficiency when cattle were fed grain combinations of SFGS with DRC or HMC. That is, when grain mixtures were fed, steer performance was better than predicted, based on the weighted value of feeding each grain individually. Steers converted feed 11.0% more efficiently and gained 11.5% faster than predicted when fed a 2/3:1/3 SFGS/HMC grain combination. When DRC was offered at 1/3 of the grain mix with SFGS, steer efficiency and gain exceeded predicted performance by 5.43 and 4.34%, respectively. Additionally, steers offered the grain mixture diets had similar gains and were as efficient as steers offered SFC diets.

No statistical differences (P>.05) in backfat, quality grade, % Choice, or liver abscess scores were observed among steers on different diets. Numerically, steers offered the DRC diet had the lowest occurrence of Choice grading carcasses. Dressing percentage was highest (P<.05) for steers offered the DRC, SFGS, and SFGS:HMC diets.

Table 1. Ingredient composition of finishing diets[a] (% of diet, dry matter basis).

Ingredient	DRC	HMC	SFC	SFGS	SFGS/ DRC	SFGS/ HMC
Dry-rolled corn	74.5	-	-	-	24.6	-
High-moisture corn	-	74.5	-	-	-	24.6
Steam-flaked corn	-	-	74.5	-	-	-
Steam-flaked grain sorghum	-	-	-	74.5	49.9	49.9
Corn silage	10	10	10	10	10	10
Soybean meal	7.5	7.5	7.5	7.5	7.5	7.5
Beef tallow	4	4	4	4	4	4
Supplement	4	4	4	4	4	4

[a] Diet balanced to contain 14.1% CP (11.6% CP with natural, 2.5% CP with urea).

Table 2. Supplement composition[a].

Ingredient	% of diet dry matter
Urea	.89
Limestone	1.00
Dical	.84
Potassium chloride	.446
Magnesium oxide	.28
Salt	.30
Zinc oxide	.02
Rumensin 80[b]	.019
Tylan 100[c]	.005
Mineral oil[d]	.16
Vitamins A, D, E premix[e]	.02
Trace mineral premix[f]	.02

[a] Diet balanced to contain .8% K, .6% Ca, .4% P, and .25% Mg.
[b] Rumensin added at 30 g/ton of complete diet.
[c] Tylan added at 10 g/ton of complete diet.
[e] Vitamins A, D, and E added at 2,000, 200, and 20 IU per pound of diet dry matter.
[f] Trace mineral contained 14.98% Zn, 12.51% Mn, 12.5% Fe, 6.66% S, 3.69% Cu, .19% I, and .05% Co.

Table 5. Economic comparison of feeding steam-flaked grain sorghum and steam-flaked corn.

Item	SFC	SFGS
Ration cost per pound, $[1]	.086	.078
Observed dry matter intake, lb	22.7	22.9
Ration cost per day, $	1.94	1.80
Observed daily gain, lb	4.40	4.09
Feed cost per pound of gain, $[2]	.441	.439

[1] Ingredient cost per ($) pound of dry matter:

SFC	.074
SFGS	.064
Corn silage	.05
Beef tallow	.20
Soybean meal	.133
Supplement	.196

[2] Cost does not reflect differences in mill throughput or efficiency of flaking the two grain types.

Table 3. Feedlot performance of cattle fed various grain diets.

Item	DRC	HMC	SFC	SFGS	SFGS/DRC	SFGS/HMC	SE
Initial wt, lb	767	777	774	777	758	752	8.8
Final wt, lb[1]	1300[a]	1314[ab]	1380[c]	1361[bc]	1384[c]	1334[abc]	23.7
Daily gain, lb[1]	3.85[a]	3.86[a]	4.40[b]	4.09[ab]	4.34[b]	4.47[b]	.12
Dry matter intake, lb	22.9	21.9	22.7	22.9	23.3	22.8	.31
Feed/Gain[1]	6.06[a]	5.75[ab]	5.17[c]	5.63[ab]	5.43[bc]	5.11[c]	.18

[1] Means within a row with different superscripts, differ (P<.10).

Table 4. Carcass data for cattle fed various grain diets.

Item	DRC	HMC	SFC	SFGS	SFGS/DRC	SFGS/HMC	SE
Backfat, in	.46	.48	.52	.51	.52	.50	.03
KPH fat, %	2.16	2.06	2.09	2.11	2.10	2.09	.06
Liver abscess score[1]	.08	.02	.03	.13	0	0	.04
Quality grade[2]	3.29	3.38	3.62	3.50	3.54	3.50	.14
% Choice	22	36	39	38	42	37	.07
Hot carcass weight, lb[3]	816.9[a]	818.4[ab]	847.2[c]	845.2[c]	848.3[c]	837.7[bc]	7.11
Dressing %[3]	61.6[ab]	61.1[a]	61.5[a]	62.2[b]	61.4[a]	61.7[a]	.23

[1] 0 = no liver abscess, 1 = 1 small abscess.
[2] 1 = Standard -, 2 = Standard +, 3 = Select, 4 = Choice -, 5 = Choice°, 6 = Choice +.
[3] Means with different superscripts differ (P<.10).

Fig. 1. Positive associative effects of flaked-grain sorghum and dry-rolled corn.

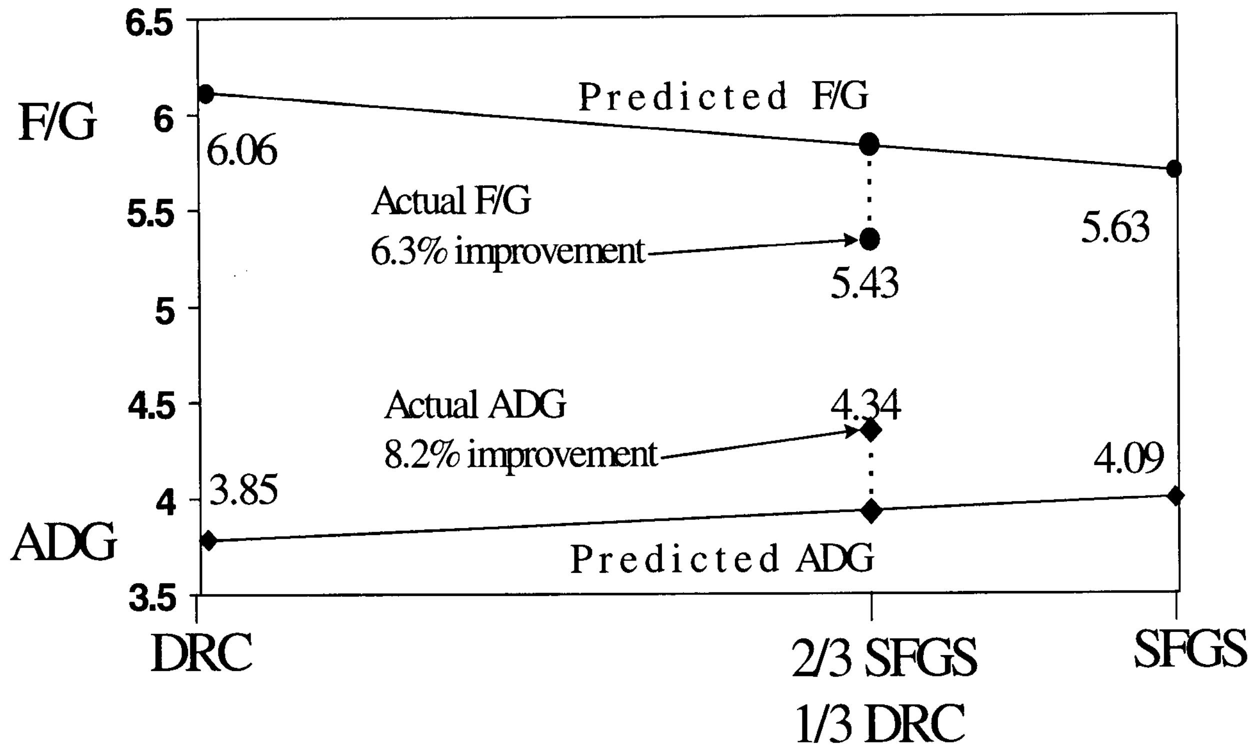
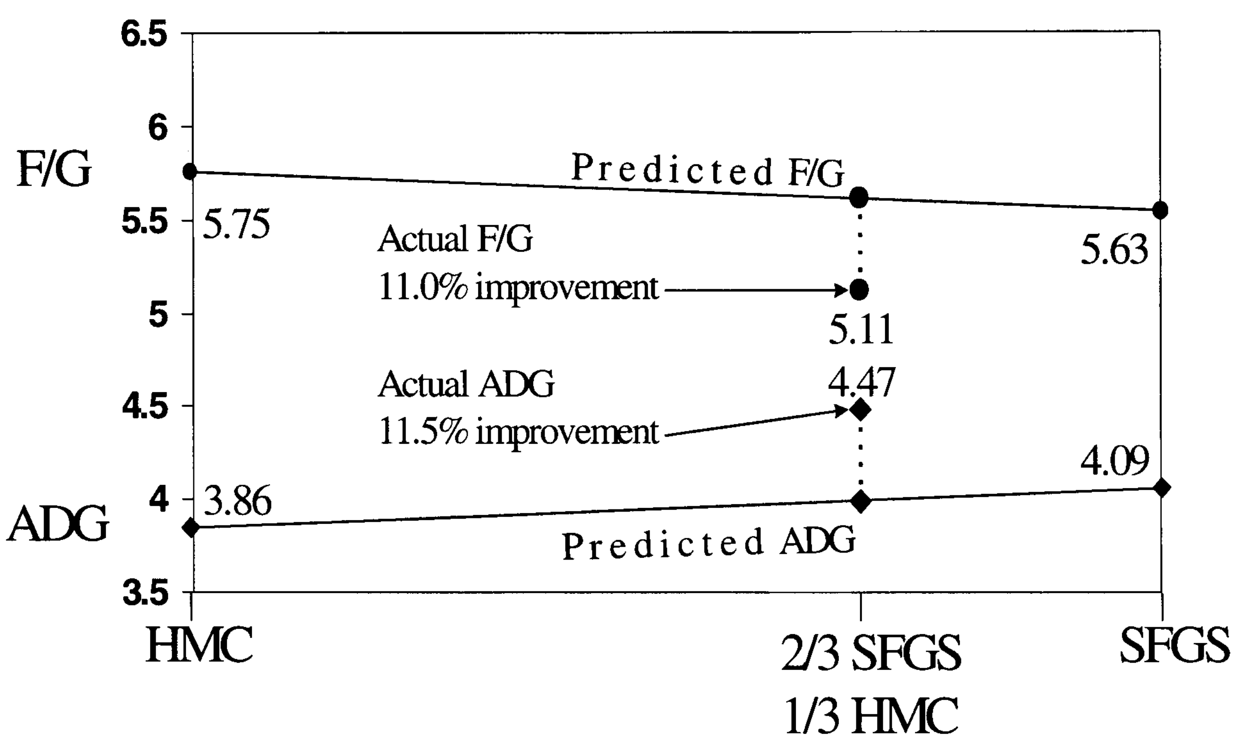


Fig. 2. Positive associative effects of flaked-grain sorghum and high-moisture corn.



FEEDING FOUR PERCENT ADDED FAT CONTINUOUSLY VERSUS INCREMENTALLY INCREASING FAT TO EIGHT PERCENT IN FINISHING DIETS FOR STEERS

by

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

SUMMARY

The objective of this experiment was to determined if finishing cattle could be adapted successfully to diets containing high levels (up to 8%) of added fat. Yearling steers (beginning weight = 708 lb) were fed diets of either 4% added fat continuously or a series of diets increasingly stepped up by 2% added fat every 30 days during a 150-day finishing phase. Steers fed fat continuously had greater average daily gain (3.64 vs 3.31 lb/day; + 9%) and hot carcass weights (792 vs 763 lb) than the steers fed the fat step-up diets. Dry matter intakes were similar between the treatments, until added fat levels reached 6 and 8% (the last 60 days on feed). Steers fed diets containing 6 or 8% fat had reduced dry matter intake by 0.6 and 1.3 lb/day, respectively, when compared to steers fed 4% fat. Even though steers fed 4% fat had a 5.4% advantage in feed conversions for the entire finishing phase, significant differences could be detected only during the first 30 days on feed, when the control diet had 4% added fat and the step-up diet had none. Steers fed 4% added fat continuously had a lower dressing percent than steers fed the fat step-up diet. Other carcass traits were similar. Incremental additions of fat in finishing cattle diets up to 8% levels appeared to hinder performance, reduce dry matter intake, and worsen feed efficiency as compared to feeding fat continuously at the 4% level.

INTRODUCTION

The inclusion of fat in finishing cattle diets has become commonplace. Adding fat increases the energy density of the ration and can improve the "condition" of the ration. Usually, fat levels do not exceed 4% of the diet. Research shows that feeding more than 4% added fat can decrease dry matter intake, lower total caloric intake, and thus compromise animal performance and feed efficiency. To overcome this reduction of dry matter intake, cattle may need to be adapted to high fat levels with "step-up" rations similar to those used for adaptation to high-starch, low-roughage, finishing diets. The objective of this trial was to determine if a step-up approach could be implemented successfully to adapt finishing cattle to extremely high-fat diets.

PROCEDURES

One hundred thirty-two steers (average weight = 708 lbs.) were stratified by weight, randomly allotted and fed in one of 12 pens (six pens per treatment). Visual appraisal of these steers indicated mostly Brahman and (or) Corriente influence and a small influence of British and (or) Continental breeding. Steer age was probably about 18 months at the start. Two steers died near the end of the feeding period and their individual data were removed from the analysis. One steer died of bovine viral diarrhea on day 87 and was on the step-up treatment. The other died by clostridia on day 109, and it was on the control treatment. All steers were implanted with Compudose about 60 days prior to placement on feed and Revalor on day 60 of the experiment. Treatments included a control diet and a series of fat step-up diets (see Table 1). The control diet contained 4% added beef tallow, and the fat step-up treatment was a series of diets with beef tallow added in cumulative increments of 2% every 30 days of feeding. The additions of fat were at the expense of steam-flaked corn. The averages of two consecutive daily weights were used as the initial and final live weights. Intermediate weights were recorded at 30-day intervals that coincided with the dietary changes in the fat step-up treatment. At the beginning of the feeding period, two step-up diets were used to accustom the steers to

Table 1. Ingredient composition of finishing diets fed (DM basis) in the treatments.

Days fed	Control[a] 1 - 150	Fat step-up 1 - 30	31-60	61-90	91-120	121-150
Steamed-flaked corn	80.9	84.9	82.9	80.9	78.9	76.9
Alfalfa hay	5.0	5.0	5.0	5.0	5.0	5.0
Beef tallow	4.0	0.0	2.0	4.0	6.0	8.0
Soybean meal	6.77	6.77	6.77	6.77	6.77	6.77
Urea	.70	.70	.70	.70	.70	.70
Limestone	1.11	1.11	1.11	1.11	1.11	1.11
Momophos	.38	.38	.38	.38	.38	.38
Magnesium oxide	.24	.24	.24	.24	.24	.24
Potassium chloride	.442	.442	.442	.442	.442	.442
Salt	.30	.30	.30	.30	.30	.30
Rumen 2x[b]	.0015	.0015	.0015	.0015	.0015	.0015
Vitamin E premix[b]	.0015	.0015	.0015	.0015	.0015	.0015
Zine oxide	.0141	.0141	.0141	.0141	.0141	.0141
Trace mineral premix[c]	.025	.025	.025	.025	.025	.025
Pellet binder	.10	.10	.10	.10	.10	.10

[a] Diet formulated to contain 13.5% CP, .8% K, .6% Ca, .3% P, and .25% Mg. Cattlyst added at 11.1 g/ton, of ionophore (dry matter basis).
[b] Vitamins A, D & E added so each lb of diet dry matter contained 2000 IU vitamin A, 200 IU vitamin D, and 20 IU vitamin E.
[c] Contains 14.98% Zn, 12.51% Mn, 12.50% Fe, 6.66% S., 3.69% Cu, .19% I and .05% Co.

the low roughage levels fed for the remainder of the finishing period. Step-up one contained 30% corn silage plus 5% alfalfa hay, and step-up two contained 15% corn silage plus 5% alfalfa hay (dry matter basis). The finishing period lasted 150 days. Feed was delivered once daily in the early morning. Feed intake and efficiency were calculated on a pen basis. Individual carcass data were collected. Statistical analysis utilized least square mean comparisons of pen averages.

RESULTS AND DISCUSSION

Cattle fed 4% (Table 2) added fat continuously throughout the feeding period had greater average daily gains than those steers fed the fat step-up diets. Being more specific, control cattle gained faster during the first 30 days on feed and during the last 60 days of the experiment. These periods coincide with dietary differences that were the greatest in fat content. Control-fed steers gained 9 percent faster than their contemporaries for the entire 150 days on feed. This amounted to an advantage of 61 lbs of slaughter weight.

Table 2 also shows that cattle can adapt readily to diets that contain up to 4% added fat. Dry matter intake did not differ between the treatments until added fat levels reached the 6 and 8 % levels. Thus, the data indicated that incrementally stepping up fat levels did not allow the cattle's digestive systems or nutrient metabolism to adapt to fat levels of 6% or greater. Steers fed 4% added fat continuously consumed nearly 1 lb of dry matter per day more than the steers fed the fat step-up diets for the entire feeding period.

Feed efficiency is a major component of profitability in finishing cattle operations. Steers fed 4% fat continuously converted diets more efficiently than those fed the fat step-up diets. This was particularly apparent during the first 30 days on feed, when the fat step-up ration contained no beef tallow. Even though feed efficiency differences were not statistically significant during the remaining 120 days on feed, the control cattle's overall feed conversion was 5.4% lower than that of steers fed the fat step-up diets.

Steers were harvested at nearly identical slaughter end points as indicated by the similarity of backfat measurements and quality grade (Table 3). Hot carcass weights reflected most of the advantage of greater average daily gain experienced by those steers fed the control diet. However, steers fed fat step-up diets had

Table 2. The effect of stepping up dietary fat content on finishing cattle performance.

Item	Treatment[a] Control	Fat step-up	P Value
Initial weight, lb	706	710	.78
Out weight, lb	1270	1212	.01
Average daily gain, lb/day			
Day 1-30	4.56	4.01	.04
Day 31-60	3.72	3.55	.48
Day 61-90	3.68	3.52	.43
Day 91-120	3.51	3.05	.01
Day 121-150	2.87	2.44	.14
Day 1-150	3.64	3.31	.02
Dry Matter Intake, lb/day			
Day 1-30	18.8	18.6	.86
Day 31-60	20.1	19.9	.81
Day 61-90	19.8	19.7	.85
Day 91-120	21.6	20.0	.01
Day 212-150	21.6	19.3	.004
Day 1-150	20.3	19.5	.18
Feed:Gain, DM basis			
Day 1-30	4.13	4.68	.04
Day 31-60	5.43	5.66	.45
Day 61-90	5.42	5.64	.44
Day 91-120	6.16	6.59	.20
Day 121-150	7.60	8.03	.59
Day 1-150	5.60	5.90	.05

[a] Treatment diet composition listed in Table 1.

Table 3. The effect of stepping up dietary fat content on finishing cattle carcass traits.

Carcass characteristics	Treatment[a] Control	Fat step-up	P Value
Hot Carcass weight, lb	792	763	.04
Dressing %	62.36	62.97	.02
Back fat, in	.32	.32	.88
Quality grade[b]	2.06	2.12	.74
Live abcesses, %	42	63	.49

[a] Treatment diet composition listed in Table 1.
[b] Qualtiy grade 2.0 = marbling score slight 00, 3.0 = marbling score small 00.

greater dressing percentages than the control steers. This difference in dressing percent probably reflected gut fill differences between the two treatments.

Stepping up added fat in finishing cattle diets to the 8% inclusion level apparently is detrimental to animal performance, feed intake, and feed efficiency. Cattle feeders who want to increase the levels of added fat to 6% or greater in the diet should do so cautiously. Other adjustments to the diet (such as protein content) might help offset the negative effects that high levels of added fat apparently cause.

FIVE-YEAR SUMMARY OF STABLE FLY MANAGEMENT

by
Gerald L. Greene

SUMMARY

A large area, pest management study demonstrated that fly parasites can reduce stable fly numbers. A Pteromalidae wasp species (*Spalangia nigroaenea*) reduced stable flies from 30 to 50% when released in cattle feedlots. Costs ranged from 14 to 32 cents/animal. An estimation system was used in conjunction with results of a parasite efficiency study. A workable system for stable fly reduction has been developed for cattle feedlots in southwest Kansas.

INTRODUCTION

A large area project was begun in 1992 with the establishment of the Fly Management Corporation to handle the financial transactions. The objectives of this expanded fly management project were to: 1) test a Kansas fly parasite under feedlot conditions; 2) develop a fly estimation system for parasite release numbers; 3) establish the number of parasites to release; 4) develop a workable integrated pest management system appropriate for cattle feedlots; and 5) analyze the economics of various control practices.

The contributions to this research project by the cooperating feedlots is certainly appreciated! The opportunity to sample fly populations from over 40 cattle feedlots really helped make this project a success at recording real-world populations of stable flies and fly parasites in southwestern Kansas. The general results and some of the difficulties will be discussed.

RESULTS AND DISCUSSION

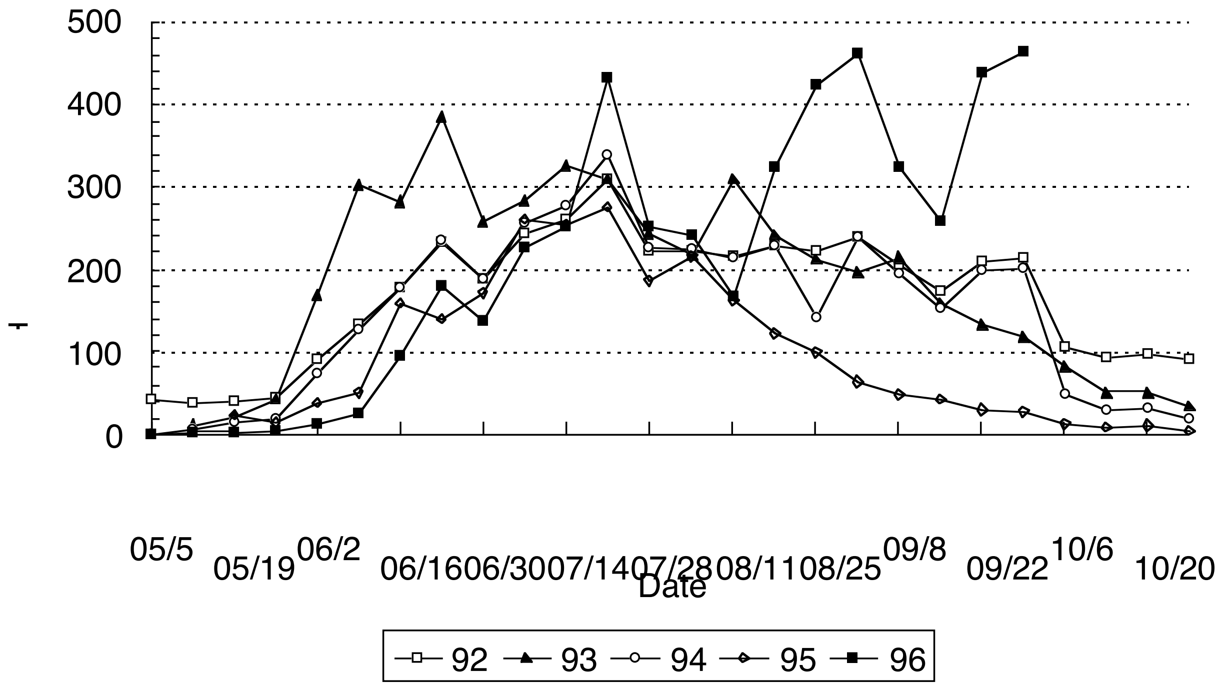
Stable fly populations varied by year with quite different weather patterns (Fig. 1). The first two years were wet, and considerable fly breeding areas occurred in most feedlots during the winter, spring, and summer. The third and fourth years were drier, and the fly breeding areas were reduced considerably. The fifth year was very dry until June, after which feedlots were continually wet but relatively free of fly breeding areas. With continuing wet conditions, 1996 was the first of 15 years of sampling when fall populations were higher than the July peak. The 1995 populations were the lowest and very low after mid August. The highest spring populations occurred during 1993 following high winter snowfall and very wet feedlot conditions.

The 1996 stable fly buildup occurred sooner than local breeding areas could have produced the numbers present. That information was very useful for a national project in cooperation with Dr. Carl Jones, University of Illinois; Dr. Jerry Hogsette, USDA ARS, Gainesville, Florida; and Dr. Alberto Broce, Kansas State University. Thus, the stable fly adults surely emigrated into this region from other breeding areas. The wind directions during that period suggested two areas of origin, southeast and southwest. Stable flies were observed in eastern Kansas and Oklahoma 2 to 3 weeks earlier than in the Garden City area, as well as, in dairies in New Mexico. The evidence that stable fly populations were emigrating to the Garden City feedlots was very strong, because fly breeding areas were absent until the very day (first spring rain over 1″, May 26) when large numbers of adults were being caught.

Rainfall and temperature are correlated strongly with adult stable fly populations. Three of the 5 years were very wet with a long season (14 to 16 weeks) of high populations, whereas 2 years were drier and had only 4 to 11 weeks of populations above 200/week. Along with wet conditions, temperatures did not surpass 100° F, which limits stable fly populations during drier, hotter years.

The fly parasite populations recorded confirmed previous observations. Stable fly parasites were predominately *Spalangia nigroaenea* with few *Muscridifurax* present. The majority of the *Muscridifurax* emerged from house fly pupae. High numbers of *S. nigroaenea* were released during 1992

Fig. 1. Adult stable fly populations recorded on Alsynite sticky traps at 30+ cattle feedlots in southwest Kansas.



and 1993, but none were available during 1994. Samples taken during 1994 from feedlots with 1992 and 1993 releases of *S. nigroaenea* showed about 10% higher populations than feedlots without releases. Some carryover was apparent, but too little to affect stable fly populations.

The numbers of parasites available for release during 1995 and 1996 were not adequate. *S. nigroanea* is more difficult to culture than other fly parasite species. At this time, it is questionable if that parasite species will be available commercially. Because *S. nigroaenea* is the major parasite of the stable fly pupae, future use of fly parasites for stable fly reduction is uncertain.

During the 1992 and 1993 parasite releases, up to 50% stable fly reductions were recorded. The 1993 releases were lower per feedlot than those in 1992. Experience during 1992 demonstrated that too many parasites were released.

Comparing parasitization in commercial-release feedlots and nonrelease feedlots (Tables 1 and 2) showed no difference in the percent parasitization of stable fly pupae. House fly pupae had double the retrieved % of other parasites (22.9 vs 11.3%). However, percents of *M. zaraptor* decreased and percents of *S. nigroaenea* were similar. The *S. nigroaenea* in stable fly pupae were 20% higher in feedlots where they were released. Total parasite levels were 16% higher from stable flies and 10% higher from house fly pupae.

Another observation during 1992 was that fly numbers dramatically increased when *S. nigroaenea* releases stopped during periods of high stable fly populations. At the same time, they did not increase in feedlots where parasite releases continued. That was one of the first field demonstrations of the effectiveness of fly parasite releases for stable fly reduction in cattle feedlots.

Considerable information on parasite sting rate, survival, and host preference has helped determine how many parasites to release in feedlots. Estimating fly populations before they develop has been more difficult. During 1996, the decline in July was interpreted to be the end of the stable fly season, which was not the case.

The fly estimating system has been successful in that the scout estimates x 4 have been close to the actual fly numbers present. Basing the parasite numbers to release on that fly estimate has been relatively accurate. Obtaining that information for each feedlot is more expensive than the cost of parasites. However, the sampling helps reduce the parasite expenses and define the appropriate number of parasites to be released, which is very helpful for the feedlot operators.

Costs of a complete program of sampling and parasites has varied considerably. The first year was 32 cents/animal, with a reduction to 26 cents/animal for the second year and then to 14 cents/animal when no parasites were available. The average annual fly costs would be about 20 cents/animal if *S. nigroaenea* was available. Without that parasite species for release to reduce stable flies, sampling would be the only expense that would be justified.

Table 1. Percent parasitization of house fly puparia (1990-1995) from cattle feedlots in southwest Kansas.

Treatment	Total	*S. nigroaenea*	*M. zaraptor*	Other parasites
No release	26.16 ± 8.23	35.85 ± 16.29	52.82 ± 13.01	11.33 ± 15.43
Commercial release	39.93 ± 17.45	40.83 ± 17.48	32.24 ± 12.50	22.93 ± 15.55
S. nigroaenea release	35.59 ± 11.19	41.56 ± 9.62	47.11 ± 4.43	11.33 ± 10.45

Table 2. Percent parasitization of stable fly puparia (1990-1995) from cattle feedlots in southwest Kansas.

Treatment	Total	*S. nigroaenea*	*M. zaraptor*	Other parasites
No release	19.03 ± 8.01	61.1 ± 9.82	23.28 ± 9.49	15.61 ± 13.84
Commercial release	17.09 ± 13.31	53.68 ± 23.62	32.14 ± 22.39	14.18 ± 23.62
S. nigroaenea release	35.5 ± 9.21	71.49 ± 3.82	19.56 ± 2.33	8.96 ± 4.15

OPTIMUM NUMBER OF STABLE FLY PARASITES TO RELEASE IN CATTLE FEEDLOTS

by
Yu-Jie Guo

SUMMARY

After estimating the stable fly population levels in cattle feedlots, the number of the parasites, *Spalangia nigroaenea*, for effective and economic release must be assessed. A series of experiments was conducted on release ratios and seasonal variation of the performance of the parasite since 1993. Generally, the fly pupae density significantly affected the parasitization results of *S. nigroaenea.* The reasonable release ratio suggested is 1:15. Overreleasing may reduce parasite efficiency. Higher seasonal temperature, especially in the manure pile, adversely impacted the parasitization of *S. nigroaenea*.

INTRODUCTION

Extensive documentation has shown that sanitation is the most important and effective practice to eliminate and minimize the stable fly (*Stomoxys calcitrans*) abundance in an integrated fly pest management program. However, because of the high mobility of the adults and diversity of the larval breeding habitats, the fly still frequently affects cattle health and weight gain. Biological control, another environmentally sound approach, with releases of *Spalangia nigroaenea*, a native, predominant, pupal parasite has been successful in controlling stable fly in more than 20 feedlots in western Kansas.

The objectives of the present experiment were (1) to evaluate the density interactions between *S. nigroaenea* and its hosts under controlled field conditions, (2) to understand the potential capacity and seasonal variation of the parasitization of *S. nigroaenea*, and (3) to determine the optimum numbers needed in the releasing program.

PROCEDURES

Three elements of the parasitization of *S. nigroaenea* were studied : (1) host density, (2) parasite density, and (3) changes in combined host and parasite densities.

Three-day-old *S. nigroaenea* and prepupated larvae of house flies (*Musca domestica*) and stable flies were used for the experiment. Ice-cream cups with screened lids were filled with mixed wheat bran and vermiculite medium. Both fly larvae and the parasites were inoculated into the containers and placed in a manure-pile for 7-10 days until fly emergence. Then all containers were brought back to the lab, and emerged flies were recorded. The remaining pupae were put individually into gelatin capsules for about 4 weeks to record the number of parasites and dead pupae. The parasite-induced mortality by stinging and feeding was corrected using the formula:

$$[1 - \frac{Ta X Cb}{Tb X Ca}]\ 100$$

Where, Ta is the number of live pupae that produced either a fly or parasite, Tb is the number of pupae provided for parasitization, Ca is the number of emerged flies from the control, and Cb is the number of pupae tested.

RESULTS AND DISCUSSION

With increasing host density, *S. nigroaenea* showed a higher oviposition rate/female, as expressed by the number of parasitized pupae (Fig. 1). On the other hand, the highest percent of parasitization was achieved when the parasite:host ratio was 1:15. After that, the proportion of the parasitized fly pupae decreased, which means lower effectiveness in controlling the fly population.

Because of the direct stinging and feeding, *S. nigroaenea* also kills a significant number of host fly pupae. This feature was definitely recognized as a contribution to the pest fly pupa mortality in addition to the normal parasitization.

When host availability is limited, increasing the density of the parasite may reduce the efficiency of the parasitization. Fecundity of female parasites was decreased significantly when the abundance of *S. nigroaenea* increased from 3 to 30 per container. This influence was greater on stable flies than on house flies.

Based on a series of tests from June to November, parasitization was associated negatively with temperature. The daily temperature in the manure pile was higher than the air temperature, which resulted from the fermentation of feeds and silage (Fig. 2). After late August, parasitization remained at a high level around 60% - 80% until early November.

Fig. 1. Effect of releasing ratio on parasitization of *S. nigroaenea*.

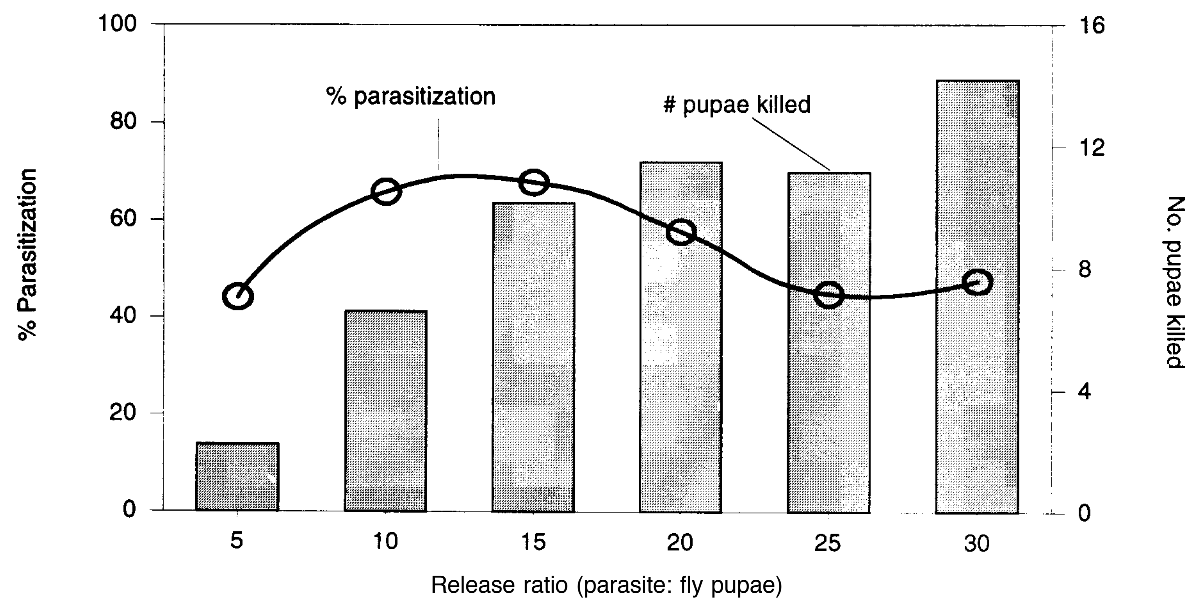
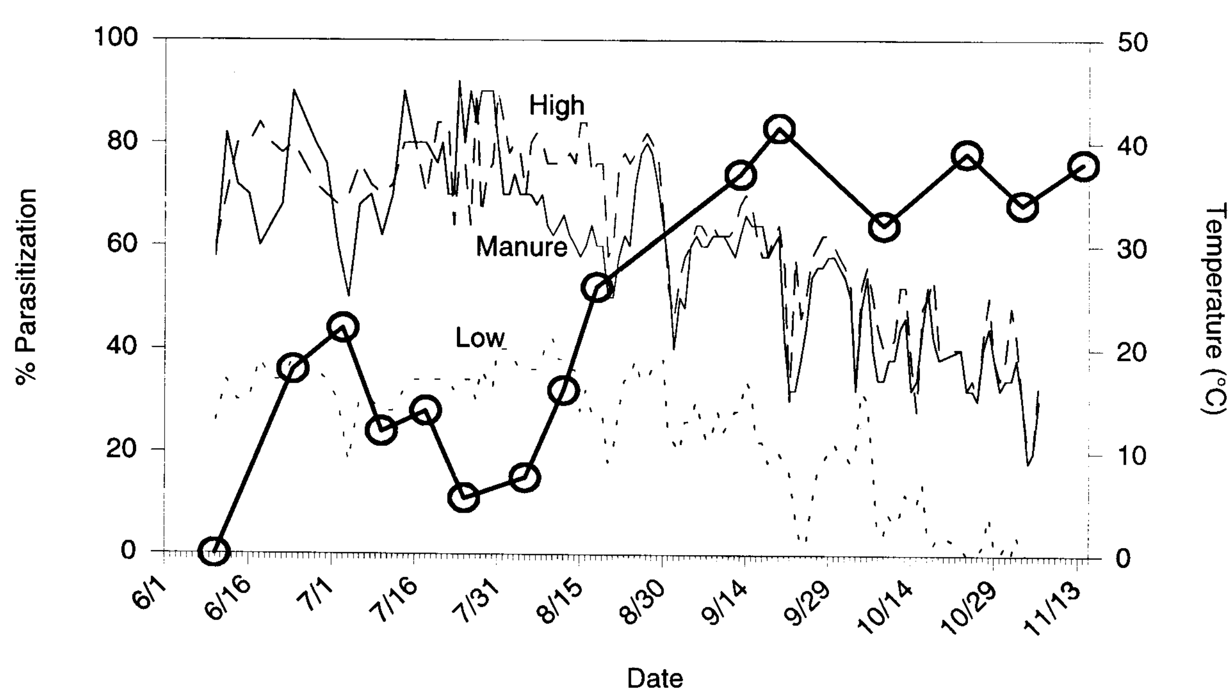


Fig. 2. Seasonal performance of *S. nigroaenea* related to temperature when the parasite/host pupae ratio was 1:15.



KSU
Southwest Research-Extension Center

INFLUENCE OF DELAYED PROCESSING AND MASS MEDICATION WITH EITHER CHLORTETRACYCLINE (CTC) OR TILMICOSIN PHOSPHATE (MICOTIL) ON HEALTH AND GROWTH OF HIGHLY STRESSED CALVES

by
Kelly Kreikemeier, Gerry Stokka, and Twig Marston

SUMMARY

The objective of this experiment was to determine if delayed processing and mass medication were effective in highly stressed, comingled calves. Four hundred thirty two calves (318 to 482 pounds) were purchased at sale barns in Missouri, Iowa, and Mississipi and hauled to Garden City, KS. The experiment had five treatments. The positive control included mass medication with injectable Micotil and processing at day 1 (the day of arrival equals day 0). The 2 by 2 factorial arrangement included mass medication with chlortetracycline (CTC) or no mass medication and processing on day 1 or day 21. Chlortetracycline was fed at 1 gm/100 lbs of body weight for 5 consecutive days beginning on day 1. Delaying processing till day 21 reduced daily gain from 2.4 to 2.2 lbs/day. Feeding CTC improved daily gain from 2.21 to 2.37 lbs/day and reduced sickness rates from 81% to 60%. Calves injected with Micotil and processed on day 1 had similar growth performance and sickness rates compared to cattle fed CTC and processed on day 1. The value of mass medication was $10.83 per head. Based on the results of this study, highly stressed calves should be processed shortly after arrival at the feedyard, and mass medication with Micotil or CTC appears to be cost effective.

INTRODUCTION

Lightweight calves purchased from the southeastern part of the United States are mostly in small groups. These calves are comingled at sale barns and order buyer facilities, a process that may take 2 or 3 days. Then they are loaded on a truck and transported for about 24 hours to feedlots in the High Plains area. In these cattle, morbidity rates of 30% to 80% and mortality rates of 3% to 10% have been reported. Because of this, mass medication upon arrival has become an increasingly important management practice in highly stressed calves.

Normal processing upon arrival at the feedyard includes implanting, treating for internal and external parasites, and vaccinating with a killed clostridial and a modified live viral vaccine. In our previous experience with highly stressed and comingled calves, peak morbidity occurs at day 5 to 7. Because a period of a few to several days is required for antibody titers to develop following a vaccination, and sickness usually occurs at day 5 to 7, the effectiveness of vaccinating on arrival is questionable. In fact, could the added stress of vaccination in highly stresssed calves actually contribute to increased morbidity?

Previous research with mass medication has shown that it is highly effective; however, the main concern is cost effectiveness. Previous research with delaying processing until 7 or 14 days after arrival has shown it to be no better than processing on arrival. Because this is the time of highest morbidity rates, perhaps processing should be delayed till day 21, when the cattle are over the shipping stress and reacclimated to the new environment. The objective of this study was to evaluate if delaying processing until 21 days after arrival, combined with mass medication, would be an effective alternative to the receiving management for comingled highly stressed calves.

PROCEDURES

The experiment utilzed 432 calves that arrived at SWREC from Sept. 1 to Dec. 6, 1995 (Table 1). The cattle originated from states to the east and south, and payweight ranged from 318 to 482 lbs. Cattle from the first three loads appeared to be mostly crossbreds of Charlois with Angus and/or Hereford. The balance appeared to be mixes of various English and Continental crosses. In terms of quality, cattle were moderate to large framed and heavily muscled. Cattle

Table 1. A summary of the date of arrival, number, payweight, and origin of calves used in this experiment.

Load	Arrival date	#Cattle	Payweight	Origin
1	Sept 1	103	459	Vienna, MO
2	Sept 7	105	455	Vienna, MO
3	Oct 5	104	482	Bloomfield, IA
4	Dec 6	121	318	Jackson, MS

in load 4 appeared to be mostly English with some Continental crossbreds. They were moderate in frame and moderately heavy muscled.

All cattle used were males, and both steers and bulls were included. Loads 1 and 2 contained about 20% bulls, load 3 had 5% , and load 4 about 50% bulls. Castration and dehorning occurred after the 56-day receiving experiment.

The experiment had five treatments. The positive control included a mass medication with injectable Micotil and processing at day 1 (the day of arrival equals day 0). The 2 by 2 factorial included mass medication with chlortetracycline (CTC) and processing on day 1 or day 21, or no mass medication.

Processing included a Ralgro implant, an injectable 8-way clostridial vaccine, an injectable four-way modified live viral vaccine, and injectable Ivermectin. The four-way viral vaccine contained bovine rhinotracheitis, virus diarrhea, parainfluenza$_3$, and respiratory syncytial virus. Micotil was injected at the recommended dosage, and CTC was fed in a pellet form daily at a rate of 1 gm of CTC/100 lbs body weight for 5 consecutive days, beginning on day 1. Chlortetracycline was incorporated into a pellet that contained 50% wheat midds:50% dehydrated alfalfa. The pellet was formulated to contain CTC at 2 gm/ lb. Thus, cattle were fed the pellet at 1/2% of body weight. We manufactured two pelleted feeds, a control and another containing CTC. In this manner, those cattle that did not receive CTC were fed a control alfalfa:wheat midds pellet at the same rate.

All cattle were purchased by one order buyer at sale barns, and 2 or 3 days were needed to accumulate each load. Cattle were purchased in several small groups to ensure that a high degree of comingling occurred. Cattle arrived here at Garden City between 7:00 AM and 10:00 AM. They were unloaded and offerred ad libitum access to water and long-stem prarie hay. At 1:00 PM, cattle were weighed and eartagged. Based on these tag numbers, cattle were allotted randomly to treatment. The next morning, cattle were weighed again; processed (if required, including injectable Micotil); and sorted to their asssigned pen. Each load of cattle was allotted randomly to 10 pens. A pen of cattle was the experimental unit. Therefore, with five treatments and 10 pens, each load of cattle resulted in two experimental replications. Load 1, 2, and 3 provided 10 or 11 head per pen, and load 4 provided 12 or 13 head per pen.

Calves were allotted and placed in their pens by noon on day 1. Then, all calves were fed either control or CTC-containing pellets. When the pellets were consumed, cattle were given ad libitum access to prairie hay. For the first 2 days, calves were fed only prairie hay and pellets. From day 3 to 7, calves were adjusted to a corn silage diet (Table 2) by reducing the amount of prairie hay and increasing the amount of the corn silage. During day 1 to 5 when pellets were fed, feed refusals left in the bunk from the previous daily feed were pushed to the end of the bunk, and pellets were fed on a slick bunk bottom. Pellets were consumed in preference to the silage diet.

Table 2. Ingredient composition of the corn silage diet.[a]

Ingredient	Percent of diet
Corn silage	78
Sunflower meal	20
Ground limestone	.97
Urea	.38
Salt	.30
Cottonseed meal	.21
Mineral oil[b]	.12
Trace mineral premix[c]	.01
Cattlyst 50[d]	.01

[a]Diet formulated to contain 13.5% CP, .70% calcium, .35% P, and .25% Mg. Vitamins A, D, and E added so each lb of diet dry matter contained 2000 IU vitamin A, 200 IU vit D, and 20 IU vit E.
[b]Added as a binder for the mineral supplement.
[c]Contained 14.98% Zn, 12.51% Mn, 12.5% Fe, 6.66% S, 3.69% Cu, .19% I, and .05% Co.
[d]Added so each ton of diet dry matter contained 10 gm of ionophore.

All cattle were weighed on day 21, and those pens allotted to the delayed processing treatments were processed at that time. Initial and final weights were based on the average of two consecutive daily weights. The experiment lasted 56 days.

Cattle were placed in pens with concrete flooring and concrete fenceline bunks. These pens had approximately 50 square feet of area and 20 inches of linear bunk space per animal. Manure was removed from the pens weekly. Calves from loads 1 and 3 were moved to pens with dirt flooring for the final 21 days of the 56-day experiment. These pens provided about 175 square feet of area and 20 inches of linear bunk space per animal.

Sick cattle were pulled based on visual unthriftiness and treated if rectal temperature was equal to or greater than 103° F. Cattle were treated with Micotil, placed back in their pen, and retreated if required 48 h later. If a third treatment was required, cattle were injected with Naxcell according to label directions. Following this protocol, an animal would receive a maximum of three consecutive treatments per illness. When an animal had watery diarrhea (only a few occasions), it was treated with Naxcell plus sulfa boluses. All dead calves were necropsied by a veterinarian.

For loads 1, 2, and 3, weather conditions were "normal" with the exception of a wet snow on about Sept. 21. For the most part, pens were dry, and weather extremes of temperature and rainfall appeared to be rather favorable for cattle comfort. For load 4, which arrived on Dec. 6, pens remained slightly wet, because of less evaporation.

The pen mean served as the experimental unit. Data were analyzed as a randomized complete block design, with block being each load of cattle. Response variables included animal performance and various measure of animal health. Treatment comparisons included contrast 1 = (CTC day 1 + CTC day 21) vs (None day 1 + None day 21), contrast 2 = (Day 1 none + Day 1 CTC) vs (Day 21 none vs day 21 CTC), contrast 3 = CTC by Day interaction, and, contrast 4 = (Micotil day1) vs (CTC day 1).

RESULTS AND DISCUSSION

To ensure that the correst dose of CTC was fed, both control and medicated pellets were sampled on 10 occasions during the manufacturing process. These samples were assayed for concentration of CTC (Table 3). Control pellets contained either no detectable CTC or levels below the meaningful level of the assay (less than 6%). For medicated pellets, values were not reported for two samples (NA), but all other values ranged from 90 to 105% of the target formulation of CTC. Therefore, the correct dose was fed to the cattle receiving the CTC treatment. Also, the feeding protocol ensured that the cattle in a pen consumed their correct dose of CTC daily before any new feed was offered.

Table 3. The level of chlortetracycline (CTC) assayed in control and medicated pellets.[a]

Sample	Control	Medicated
1	3	90
2	0	NA[b]
3	6	95
4	2	95
5	2	105
6	4	95
7	0	100
8	2	95
9	0	90
10	3	90

[a]Values are expressed as a percent of target values.
[b]NA = not available.

Starting weight for cattle used in this experiment varied from 417 to 424 lbs (Table 4). After 56 days, the final weight varied from 539 to 561 lbs and was affected by treatment. Cattle fed CTC were heavier than cattle that received no mass medication (P = .01), and cattle processed on day 1 were heavier than cattle processed on day 21 (P = .03). Use of CTC or day of processing had no significant effects on feed intake, but cattle that were fed CTC and processed on day 1 consumed less feed (P = .07) than cattle injected with Micotil and processed on day 1. Cattle fed CTC had greater daily gain than cattle that received no mass medication (P = .02), and cattle processed on day 1 gained faster than cattle processed on day 21 (P = .01). Effects on feed efficiency also were significant. Cattle fed CTC were more efficient than cattle that received no mass medication (P = .01), and cattle processed on day 1 were more efficient than cattle processed on day 21 (P = .01). For daily gain and feed efficiency, cattle that received Micotil and were processed on day 1 were similar to cattle that were fed CTC and processed on day 1(P > .21).

One concern of feeding CTC at the level used in this study is that microbial growth in the rumen might be less compared to that for cattle receiving no CTC. This, in turn, might lessen ruminal fiber fermentation, which then would lower feed intake and reduce growth performance. Because feed intake was similar between cattle fed CTC and control pellets (excluding Micotil), reduced ruminal function apparently did not occur. In fact, the improved feed efficiency with CTC feeding suggests that the opposite occurred, i.e., that ruminal function/fermentation was improved with CTC feeding.

Table 4. Effect of mass medication and delayed processing on growth performance and animal health in highly stressed calves.

	Mass medication[a] and day of processing[b]									
Item	Micotil day 1	None day 1	CTC day 1	None day 21	CTC day 21	SE	1[c]	2	3	4
Pen no.	8	8	8	8	8					
Cattle no.	86	85	87	88	87	.2				
Initial weight, lbs	424	417	421	421	422	2.1	.25	.28	.51	.31
Final weight, lbs	561	545	561	539	547	4.4	.01	.03	.38	.98
Feed intake, lbs DM/d	13.31	12.85	12.76	12.73	12.82	.21	.99	.89	.69	.07
Daily gain, lbs	2.46	2.30	2.51	2.12	2.24	.07	.02	.01	.52	.58
Feed/gain	5.48	5.71	5.23	6.18	5.80	.14	.01	.01	.73	.21
Initial sickness										
Percent sick	59.4	79.2	61.2	83.9	58.8	6.8	.01	.87	.60	.84
Rectal temp, F	104.2	104.3	104.5	104.4	104.4	.17	.67	.77	.41	.23
Subjective score[d]	1.33	1.44	1.60	1.39	1.38	.07	.33	.09	.21	.01
Treatments, no.	1.21	1.26	1.31	1.31	1.29	.09	.81	.87	.70	.44
Day of sickness	13.4	5.3	6.2	6.1	7.5	1.1	.34	.38	.81	.01
Repeat sickness										
Percent sick	27.5	30.7	29.8	34.9	26.1	6.8	.43	.95	.51	.83
Rectal temp, F	103.7	103.9	103.9	104.2	104.1	.33	.97	.52	.83	.70
Subjective score[d]	1.49	1.49	1.45	1.52	1.45	.20	.75	.93	.93	.90
Treatments, no.	1.15	1.48	1.29	1.42	1.43	.16	.52	.77	.46	.55
Day of sickness	16.9	15.8	17.1	17.2	18.7	1.9	.39	.34	.94	.95
Deaths, no.	0	1	2	3	2	1.3	1.0	.46	.46	.30

[a]CTC = chlortetracycline.
[b]Cattle were processed initially (day 1) or 21 days after the experiment started.
[c]Contrast 1 = (CTC day 1 + CTC day 21) vs (None day 1 + None day 21)
Contrast 2 = (Day 1 none + Day 1 CTC) vs (Day 21 none vs day 21 CTC)
Contrast 3 = CTC by Day interaction
Contrast 4 = (Micotil day1) vs (CTC day 1)
[d]A visual appraisal of the animals' condition at the time of first treatment. 1 = mild, 2 = moderate, and 3 = severe.

A high incidence of animal sickness occurred in this study. This was expected, given the protocol used for purchasing the calves. The data on cattle illness are presented as "initial sickness" and "repeat sickness". Approximately 70% of the calves in the experiment became ill shortly after arrival, and 30% of the calves became sick again 10 days later.

For the initial sickness, feeding CTC resulted in reduction in incidence from 81% to 60% (P = .01). The overall sickness rate was similar for cattle injected with Micotil and processed on day 1 and compared to cattle fed CTC and processed on day 1. Rectal temparatures at the first pull was similar across treatments and averaged about 104.5 F. A visual appraisal of the animals on first pull (subjective score), showed that cattle processed on day 21 appeared less sick than cattle processed on day 1. (P = .09). Also, cattle that were injected with Micotial and processed on day 1 appeared less sick than cattle fed CTC and processed on day 1 (P = .01). No differences occurred in the number of treatments required per sickness, but big differences occurred in the time when the animals became sick. In four of five treatments, cattle became sick at an average of 5 to 7 days into the experiment. However, cattle injected with Micotil and processed on day 1 became sick at day 13, whereas cattle fed CTC and processed on day 1 became sick at day 6 (P = .01).

About 30% of the animals in the experiment became ill for a second time. This occurred at about day 17 into the experiment, and the day when sickness occurred was similar across treatments. An observation worth noting is that for cattle injected with Micotil and processed on day 1, "initial sickness" occurred at day 13 and "repeat sickness" occurred at day 17. In the other four treatment groups, initial sickness occurred at about day 6 and repeat sickness occurred at day 17. We have no good explanation for this difference.

Based on the day that sickness occurred, the injection of Micotil seemed to be highly effective in delaying the onset of sickness. However, the same number of animals eventually became sick compared to cattle that were fed CTC. Because an injection of Micotil delayed the onset of initial sickness, we might have expected less repeat sickness in these cattle. However, that did not occur.

Overall, mortality was just less than 2% in these calves during the 56-day experiment, and no significant treatment effects occurred. Because of the high value associated with mortality, we should note that no mortality occurred in cattle injected with Micotil and processed on day 1. Also, numerically greater mortality occurred in cattle processed at day 21 compared to cattle processed on day 1. Several more pens of cattle in a study of this type would be required for differences in mortality to be statistically significant. Necropsies of the dead animals indicated that all mortality could be attributed to pneumonia with *Pasturella* the likely cause.

The overall improvement from mass medication observed in this study has been demonstrated in other studies. However, the economic improvement often may pay only for the added cost associated with mass medication. In this study, the added value of reduced sickness associated with mass medication was worth an additional $4.35 per head (Table 5). The added value of additional weight gain from mass mediction was worth $6.48 per head. Therefore, in this study, the total value of mass medication was $10.83 per head. We did not put a value on differences in mortality because they were not statistically significant.

Based on the results of this study (and two previous studies), delayed processing of incoming calves that are comingled and highly stressed apparently has no economic advantage. Feeding CTC at the levels used in this study was highly effective in improving growth performance and reducing overall sickness. Cattle injected with Micotil and processed on day 1 had similar growth performance and sickness rates compared to cattle fed CTC and processed on day 1.

Table 5. Economic advantage to mass medication.[a]

Item	No mass medication	Mass medication	Economic advantage
Treatment cost[b]	$16.31	$11.96	$4.35
Value of weight gain[c]	$74.26	$80.74	$6.48
Total			$10.83

[a]Values are expressed per animal.
[b]A treatment cost of $20.00 per sick animal was used. Each value arrived at by multiplying the percent sickness times $20.00.
[c]Weight gain is valued at $.60 per pound of weight gain. Value arrived at by multiplying total weight gain (lbs) times $.60.

THE EFFECT OF THE TIMING OF VACCINATION ON HEALTH AND GROWTH PERFORMANCE OF COMINGLED CALVES

by
Kelly Kreikemeier, John Johns, Gerry Stokka, Darrh Bullock, Twig Marston, and Dave Harmon

SUMMARY

The objective of this experiment was to determine the effectiveness of an early vaccination program in comingled, highly, stressed calves. Herds from 16 cow-calf producers in Kentucky were used in this experiment. The number of steer calves per herd ranged from three to 38, and the experiment included 217 steer calves that were transported to Garden City, KS. The experiment included three treatments; 1) vaccinate calves with a killed viral vaccine at the farm while the animals were still suckling cows; 2) vaccinate with a modified live viral vaccine after the calves were weaned, transported to a sale barn, and comingled; and, 3) vaccinate with a modified live viral vaccine after the calves arrived at the feedyard. Growth performance was similar across treatments for the 56-day study, but calves vaccinated before weaning had improved growth performance during the initial 21 days after arrival at the feedyard. Vaccinating calves before weaning resulted in 27% sickness and one treatment per sick animal, vaccinating at comingling resulted in 33% sickness and 1.36 treatments per sick animal, and vaccinating at the feedlot resulted in 37% sickness and 1.14 treatments per sick animal. We conclude that vaccinating calves before weaning is beneficial, and vaccinating calves at comingling has no advantage over vaccinating upon arrival at the feedyard.

INTRODUCTION

Beef production east of the Mississippi river is dominated by adequate supplies of forage. Thus, commercial cow-calf operations outnumber feedlots. In October and November, calves are weaned off the cows and hauled directly to the sale barn. Because beef production is mostly in small herds, calves are comingled at purchase time in order to "put together" a semiload. This stress plus 24 hours in transit to the feedyards or wheat pasture of the High Plains usually results in high morbidity and mortality of these calves.

Studies to evaluate the correct receiving management of these comingled and highly stressed calves have been conducted. Some studies have considered various nutritional implications including dietary energy, protein, vitamins and minerals, and feeding probiotics. Other studies have dealt with mass medication and various vaccination programs. For studies including timing of vaccination, the treatment comparisons have been limited to the time that cattle are comingled versus arrival at the feedyard. Generally, results have shown no differences. It is logical that for a vaccine (against the viral pathogens) to be effective, cattle should be allowed several days after vaccination before they are comingled, to enable effective antibody titers to develop. In fact, this is recommended in many preconditioning programs.

Few data exist to evaluate the effectiveness of early vaccination programs and determine their cost effectiveness for the production situation just described. Therefore, the objective of this study was to determine the effectiveness of an early vaccination program and to compare it to a typical situation where calves are comingled, hauled to the feedyard, and then vaccinated.

PROCEDURES

This study was conducted in cooperation with researchers at the University of Kentucky. The experiment included three treatments; 1) vaccinate calves with a killed viral vaccine at the farm while the animals were still suckling cows; 2) vaccinate with a modified live viral vaccine after the calves were weaned, transported to a sale barn, and comingled; and, 3) vaccinate with a modified live viral vaccine after the calves arrived at the feedyard.

Herds from 16 cow-calf producers in Kentucky were used in this experiment. The number of steer calves per herd ranged from three to 38, and the experiment included 217 steer calves. At the time that calves were selected and vaccinated on the farm, weights ranged from 465 to 675 lbs. Calves were sorted off the cows, tagged, and vaccinated with a killed viral vaccine (if required) and then turned back with the cows. This occurred between October 15 and October 30. On the morning of November 11, calves were weaned, loaded, and hauled up to 150 miles to the sale barn at Lexington, KY and comingled as one group. At that time, all calves were worked, and those calves that had received a vaccination between October 15 and October 30 were revaccinated with the same killed viral vaccine. Calves allotted to treatment two received an initial vaccination at that time. They were vaccinated with a modified live viral vaccine. Calves assigned to treatment three did not receive a shot.

Calves stayed in their pens with ad libitum access to prairie hay and water for 48 hours and then were loaded on trucks on the morning of November 13. After about 22 hours in transit, the cattle arrived here at Garden City at about 7:00 AM. They were unloaded and placed in pens with ad libitum access to water and prairie hay. At 1:00 PM, cattle were weighed and processed. Processing included a Ralgro implant, injectable Ivermectin, and vaccination with a killed clostridial vaccine. Only calves allotted to treatment three were vaccinated with a modified live viral vaccine. Within each treatment group, calves were allotted randomly to seven pens. On the next day, calves were weighed again and sorted to the assigned pen. At day 21, cattle were weighed, and those in treatments two and three were revaccinated with a modified live viral vaccine. Initial weights and final weights (taken at day 56) were based on the average of two consecutive daily weights.

The vaccines used were as follows. The killed vaccine was Biara Shield-5, manufactured by Grand Laboratories of Larchwood, IA. The modified live virus vaccine was BRSV Vac-9, manufactured by Miles Laboratories of Shawnee Mission, KS. The products differ in that one contains a killed virus and the other a modified live virus. The four-way product contained bovine rhinotracheitis, virus diarrhea, parainfluenza$_3$, and respiratory syncytial virus.

Calves were adapted from prairie hay to a corn silage diet (Table 1) by gradually reducing the amount of prairie hay offered and slowly increasing the amount offered of a corn silage. This took 5 days.

Table 1. Ingredient composition of the corn silage diet.[a]

Ingredient	Percent of diet
Corn silage	78
Sunflower meal	20
Ground limestone	.97
Urea	.38
Salt	.30
Cottonseed meal	.21
Mineral oil[b]	.12
Trace mineral premix[c]	.01
Cattlyst 50[d]	.01

[a]Diet formulated to contain 13.5% CP, .70% calcium, .35% P, and .25% Mg. Vitamin A, D, and E added so each lb of diet dry matter contained 2000 IU vitamin A, 200 IU vit D, and 20 IU vit E.

[b]Added as a binder for the mineral supplement.

[c]Contained 14.98% Zn, 12.51% Mn, 12.5% Fe, 6.66% S, 3.69% Cu, .19% I, and .05% Co.

[d]Added so each ton of diet dry matter contained 10 gm of ionophore.

Initially, cattle were placed in pens with concrete flooring and concrete fenceline bunks. These provided approximately 50 square feet of area and 20 inches of linear bunk space per animal. Manure was removed from the pens weekly. After 14 days, calves were moved to a different set of pens that had dirt flooring, a concrete feeding apron, and concrete fenceline bunks. These pens provided about 110 square feet of area and 20 inches of linear bunk space per animal. The experiment lasted 56 days. For the duration of the experiment, precipitation was minimal, temperature extremes were not severe, and the overall environment/weather appeared favorable for receiving calves at this time of year in southwest Kansas.

Sick cattle were pulled based on visual unthriftiness and treated if rectal temperature was equal to or greater than 103ϒF. Cattle were treated with Micotil, placed back in their pen, and retreated 48 h later, if required. If a third treatment was required, cattle were injected with Naxcell according to label directions. Following this protocol, an animal would receive a maximum of three consecutive treatments per illness. When an animal had watery diarrhea (only a few occasions), it was treated with Naxcell plus sulfa boluses. All dead calves were necropsied by a veterinarian.

In terms of quality, the cattle varied. The sire breed for about 50% of the cattle was Charolais, with the balance being crossbreds of Beef Master, Chianina, Simmental, Gelbvieh, Limousin, and Angus. Most of the cattle were moderate to large framed and moderately to heavily muscled. A small percentage were medium to small framed and moderately muscled.

The pen mean was the experimental unit. Data were analyzed as a completely random design. Treatment means were separated with a t-test.

RESULTS AND DISCUSSION

According to the protocol used to gather the calves, the high degree of comingling, and 48 hours at the sale barn followed by 22 hours in transit should have resulted in a high degree of stress. Also, this system is typical for a large amount of cattle that originate from the southeast and arrive here in the High Plains.

At the time calves were originally sorted, identified, and processed, they weighed 543 to 550 lbs (average within treatment, Table 2). Upon arrival here at Garden City, calves weighed only 9 to 12 lbs more. Even though some 3 to 4 weeks had passed, this might be expected, because the farm weights were unshrunk weights, and a large amount of shrink undoubtedly occurred for the 4 days prior to arrival here in Garden City. No significant differences in body weight occurred at day 21 or day 56 of the experiment.

Feed intake did not differ ($P > .10$) across treatments during the initial 21 days of the experiment and averaged just over 12 lbs/head/day. From day 21 to day 56, feed intake was greater in cattle vaccinated at the feedyard ($P < .10$). Averaged across the entire 56-day experiment, feed intake was not affected by treatment ($P > .10$).

For the initial 21 days, daily gain was numerically greater ($P > .10$), in calves that were vaccinated before weaning. From day 21 to day 56, daily gain was significantly greater in cattle vaccinated at the feedlot compared to cattle vaccinated before weaning ($P < .10$). Daily gain for cattle vaccinated at comingling was intermediary. For the entire 56-day experiment, daily gain was similar across treatments.

For feed to gain, a similar trend occurred. No significant differences ($P > .10$) occurred in the initial 21 days, but numerically, cattle vaccinated before weaning tended to be the most efficient. From day 21 to day 56, calves vaccinated at the feedlot were more efficient than calves vaccinated before weaning ($P < .10$). Averaged over the entire 56-day experiment (day 1 to day 56), feed efficiency was similar across treatments.

Although no significant differences ($P > .10$) occurred, vaccinating calves before weaning resulted in 27% sickness, vaccinating at comingling resulted in 33% sickness, and vaccinating at the feedlot resulted in 37% sickness. Rectal temperature and the visual appraisal of the sick animal were similar across treatments. In calves that were vaccinated before weaning, those that became sick required only one treatment, whereas calves vaccinated at comingling required an average of 1.36 treatments ($P < .10$). In this study, calves became sick at an average of 1.5 to 3 days into the experiment. Although numerical differences were small, calves vaccinated at comingling became sick sooner than calves vaccinated at the feedyard ($P < .10$). One dead calf occurred per treatment. Necropsies of the dead animals indicated that mortality could be attributed to pneumonia, with *Pasturella* the likely cause.

Overall, vaccinating calves at comingling apparently had no advantage compared to vaccinating at the feedlot. Vaccinating at comingling resulted in slightly reduced growth performance, and calves became sick sooner and required slightly more treatments per animal compared to calves vaccinated at the feedyard. An explanation for this observation is that perhaps vaccinating at comingling added to the stress load. This, in turn, may have increased animal sickness and reduced animal performance.

Another important observation to note is that, although growth performance was similar for the entire 56-day experiment, calves vaccinated before weaning had numerically better growth performance from day 1 to day 21. This also corresponds to less sickness and fewer treatments needed for those animals that became sick. However, in this study, calves vaccinated at comingling or at the feedyard compensated from day 21 to day 56, such that overall performance was similar at the end of the experiment.

Based on the results of this study, we conclude that early vaccination has an advantage, specifically, improved animal health. Perhaps even more improvement could be obtained, if calves were vaccinated at about 6 weeks before and then revaccinated about 2 weeks before comingling and shipping.

Table 2. Effect of timing of vaccination on growth and health of comingled calves.

Item	Timing of vaccination			
	Before weaning	Comingling	Arrival at feedyard	SE
Pens, no.	7	7	7	
Cattle, no.	75	73	70	
Farm weight, lbs	544	543	550	4.9
In weight, lbs	552	557	561	4.1
Day 21 weight, lbs	609	607	609	5.8
Day 56 wt, lbs	705	709	721	7.5
Feed intake, lbs DM/day				
day 1 to day 21	12.36	12.04	12.29	.31
day 21 to day56	19.25[a]	19.34[a]	20.12[b]	.29
day 1 to day 56	16.67	16.61	17.17	.26
Average daily gain, lbs				
day 1 to day 21	2.71	2.37	2.28	.22
day 21 to day 56	2.75[a]	2.92[ab]	3.20[b]	.13
day 1 to day 56	2.73	2.71	2.85	.11
Feed/gain				
day 1 to day 21	4.75	5.36	5.64	.40
day 21 to day 56	7.10[a]	6.64[ab]	6.35[b]	.24
day 1 to day 56	6.15	6.19	6.07	.17
Morbidity				
Percent sick	27.0	32.9	37.1	4.9
Rectal temp, F	104.2	103.9	104.5	.43
Subjective score[1]	.51	.68	.55	.09
Treatments, no.	1.0[a]	1.36[b]	1.14[ab]	.13
day of sickness	1.93[ab]	1.56[a]	2.82[b]	.39
Dead, no.	1	1	1	

[abc]Means within a row with unlike superscripts differ ($P < .10$).

[1]A visual appraisal of the animals condition at the time of first treatment. 0 = mild, 1 = moderate, and 2 = severe.

ACKNOWLEDGMENTS

Appreciation is expressed to these organizations for assisting in beef cattle research at the Southwest Research-Extension Center in 1995 to 1996:

Bank IV, Garden City, KS
Barton Co. Land & Cattle Co., Ellinwood, KS
Bayer, Shawnee Mission, KS
Biotal Inc., Eden Prairie, MN
Biozyme, Inc., St. Joseph, MO
Brookover Cattle Company, Scott City, KS
Brookover Enterprises, Garden City, KS
Cattlemen's Feedlot, Turon, KS
Pete Clair, Dodge City, KS
Elanco, Indianapolis, IN
5-N Feeders, Inc., Johnson City, KS
Farnam Companies, Inc, Phoenix, AZ
Fidelity State Bank, Garden City, KS
Floyd Feeders, Johnson, KS
Bradley Fuller, Lakin, KS
Garden City PCA, Garden City, KS
Grant Co. Feeders, Ulysses, KS
Great Plains Chemical, Garden City, KS
Hitch Feeders II, Garden City, KS
Hoechst-Roussel Agri-Vet Company, Kansas City, MO
Hoffmann-LaRoche, Inc., Paramus, NJ
Hubbard Block Division,White Wood, SD
IBP, Holcomb, KS
Ingalls Feed Yard, Ingalls, KS
Kansas Sorghum Commission, Topeka, KS
Kearny County Feeders, Inc, Lakin, KS
Lane Co. Feeders, Inc., Dighton
Lynch Feedyard, Inc., Dodge City, KS
Mallinckrodt Veterinary, Inc., Medicine Lodge, KS
Meadowlark Angus, Copeland, KS
Merck Agvet Division, St. Louis, MO
Northern Sun, Goodland, KS
Perrier Feed Yard, Dodge City, KS
Pfizer Agricultural Division, Lee's Summit, MO
Price Cattle Company, Garden City, KS
Royal Beef Inc., Scott City, KS
S-Bar Ranch Feedlot, Sublette, KS
Reeve Cattle Co., Inc., Garden City, KS
Rex Stanley Feed Yard, Inc., Dodge City, KS
Sublette Feeders, Sublette, KS
Syntex Animal Health, Des Moines, KA
Syracuse Feeders, Syracuse, KS
Ulysses Feeders, Ulysses, KS
Walco International, Inc., Garden City, KS
Warner Feedyard, Cimarron, KS
Western Feedyard Inc., Johnson, KS
Winger Feedyard, Inc., Johnson City, KS

Appreciation is also extended to Marvin Cronin, Jr. and Marilyn Vass (Agricultural Technicians) for animal care, feeding, and data collection; Roberta Huddleston and Jovita Baier for manuscript typing; Eileen Schofield for manuscript editing; and Julie White (Agricultural Technician) and Pamela Selby (Laboratory Technician) for their work on the entomology research.

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Contribution no. 97-154-S from the Kansas Agricultural Experiment Station.

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SRP 773 November 1996