no differences in composition of feces were observed. Results suggest that antibiotic feeding may alter site of digestion or acid production by microorganisms in the large intestine.

The effects upon cattle performance of Avoparcin, Ralgro and their combination is shown in Table 4. A report from Nebraska suggests that Avoparcin is more effective when cattle are implanted. The two materials produced additive effects on rate of gain and feed efficiency in our trial. Comparison of Avoparcin (60 g per ton) with monensin (30 g per ton) in this trial is presented in Table 5. Most previous trials have demonstrated that Avoparcin depresses feed intake less than does monensin when added to a ration and thereby increases rate of gain. In this study, feed intake was depressed more with Avoparcin than monensin. Also, gains of heifers fed Avoparcin were 3.3 percent less than control cattle while with monensin, gains were 1.5 percent above that of control cattle. Feed efficiencies for the 112 days of Avoparcin feeding were improved by 5.5 and 6.0 percent with the two compounds. Avoparcin tended to reduce fecal pH and increase fecal starch whereas monensin had opposite effects. Carcasses of cattle fed Avoparcin tended to be fatter and have a higher fat cover and yield grade than other cattle (Table 6).

Results of four earlier trials in various states with feedlot heifers fed Avoparcin have shown increased rates of gain (3.7 percent) and an improvement in feed efficiency (7.2 percent) with Avoparcin at 60 g per ton. Why gains and feed intakes were depressed during feeding and after Avoparcin withdrawl for cattle fed Avoparcin in this trial is unclear, but improvements in efficiency of feed use indicate that Avoparcin will be a useful, effective feed additive which will act equally well with or without an anabolic implant.

Thiopeptin or High Roughage in Starting Rations for Feedlot Steers

D.R. Gill, F.N. Owens,
R.W. Fent and R.K. Fulton

Story in Brief

Thiopeptin was fed at 0 or 11 ppm to two groups of 560-pound growing steers not adapted to a high concentrate ration, and a third group of steers was started on a ration diluted with roughage (40 percent cottonseed hulls for 10 days followed by 20 percent cottonseed hulls for 10 days). Six pens of seven steers were fed each of the three rations. Over the first 28 days, gains were 14 percent greater and feed efficiency was 10 percent improved ($P<.05$) by thiopeptin addition to the 90-percent concentrate ration. Thiopeptin was removed from the ration on day 28. The advantage of 16 pounds for cattle fed thiopeptin at 28 days increased to 32 pounds by day 160. Over the 160-day feeding trial, thiopeptin improved ($P<.05$) gain and feed efficiency by 7 and 6 percent respectively. Carcass characteristics were unchanged with thiopeptin feeding. Performance and carcass characteristics of the steers started on the roughage ration and those fed the high concentrate ration with added thiopeptin were similar.

Introduction

Thiopeptin (Merck product MK-747) is a narrow spectrum antibiotic (Muir and Barreto, 1979) which decreases acidosis in sheep (Kezar and Church, 1979) and cattle (Mies *et al.*, 1978) and may increase rate of gain in cattle (Gill *et al.*, 1979). Previous trials had fed thiopeptin at 11 ppm throughout the feeding trial. Since the acidosis is generally most prevalent during the first several weeks of a feeding trial, thiopeptin was fed for only the first 28 days in this trial. For comparison with these steers abruptly started on a high concentrate ration, another set of steers was gradually adapted to the high concentrate ration by stepwise reduction of roughage concentration in the ration. The objectives of this experiment were to determine the effect of supplemental thiopeptin on feedlot health, performance and carcass characteristics of growing-finishing steers.

Materials and Methods

One hundred twenty-six steer calves (560 lb) were stratified by breed (Hereford, Angus, Hereford by Angus cross) and blocked by weight into 6 blocks. Treatments were randomly assigned within each block of three pens to one pen of seven animals. Steers received thiabendazole paste as well as vaccination for bovine rhinotracheitis, leptospira pomona, bovine virus diarrhea, parainfluenza 3, blackleg and malignant edema following arrival by truck from Kansas. Cattle received no estrogenic implants. Steers had been fed a high roughage pelleted ration for several weeks prior to shipment.

Ration compositions are presented in Table 1. Cattle hereafter designated as "control" were fed the ration with 10 percent cottonseed hulls following processing until slaughter. The "thiopeptin" cattle received the 10 percent cottonseed hull ration with 11 ppm added thiopeptin from the time of processing for the first 28 days and the 10 percent cottonseed hull ration without thiopeptin thereafter (day 29 to slaughter). The "standard" cattle were fed the 40 percent cottonseed hull ration for 10 days, the 20 percent cottonseed hull ration for the subsequent 10 days and the 10 percent cottonseed hull ration from day 21 until slaughter. Feed was available *ad libitum* through self-feeders. Feed was removed from feeders and weighed when rations were changed and when cattle were weighed. Cattle were weighed individually on arrival in December of 1979 and 28, 84, 112 and 159 days later. For the first 28 days, steers were appraised for health status (nasal discharge, diarrhea, incoordination, bloat, gaunt appearance), and the incidence of sick days was tabulated. Cattle were trucked to Booker, Texas, and slaughtered after 160 days on feed. At that time liver abscesses were scored and carcass

Table 1. Ration composition

	Roughage level, %		
Item	40	20	10[a]
	%		
Corn grain, steam rolled	9.25	47.25	72.25
Cottonseed hulls	40	20	10
Alfalfa meal, dehydrated	40	20	4
Soybean meal	5	7	7.5
Molasses, cane	5	5	5
Calcium carbonate	0	.50	1.00
Salt	.25	.25	.25
Vitamin A[b]	+	+	+
Trace mineral mix	+	+	+
Metabolizable energy, Kcal/g	2.27	2.76	3.06

[a]With or without 11 ppm thiopeptin added for days 0 to 28.

[b]To contain 33,200 IU per kg of ration.

characteristics recorded. Final weight was calculated from hot carcass weight and a mean dressing percentage of 62.

Results and Discussion

Daily gains of cattle fed thiopeptin the first 28 days of the trial exceeded ($P<.05$) those of control cattle fed the high concentrate ration by 16 pounds (Table 2). This difference increased to 36 pounds over the subsequent 128 days. Standard cattle brought onto feed gradually had rates of gain virtually equal to the cattle fed thiopeptin. Feed intake was greatest for cattle brought onto feed gradually, especially during the first 28 days when extra roughage was present in the ration ($P<.05$). The amount of non-roughage feed consumed by these cattle, however, was least ($P<.05$) for this group. Feed efficiencies tended to favor the cattle fed thiopeptin during all intervals of the trial with superiority over control and standard workup cattle of 6.5 and 1.8 percent respectively.

Table 2. Cattle performance with thiopeptin

Item	Control	Thiopeptin	Regular	LSD
Pens	6	6	6	
Steers	42	42	42	
Weight, lb				
Initial	560	559	562	2.4
28 day	672	687	692	
159 day[a]	1011	1043	1050	
160 day[b]	1004[a]	1039[b]	1038[b]	21.1
Daily gain, lb				
0-28	3.98[a]	4.54[b]	4.66[b]	.404
28-159[d]	2.78[a]	2.92[b]	2.93[b]	.086
0-159[d]	2.81[a]	3.02[b]	3.05[b]	.106
0-160[e]	2.78[a]	3.00[b]	2.97[b]	.124
Feed intake, lb DM/day				
0-28	15.5[a]	15.8[a]	19.1[b]	1.28
0-28 (conc)[f]	15.5[b]	15.8[b]	12.7[a]	1.29
28-159	18.9	19.1	19.3	.78
0-159	18.3[a]	18.5[a]	19.2[b]	.72
0-159 (conc)	18.3	18.5	18.1	.74
Ration ME (calc)	3.06	3.06	2.99	
Feed/gain				
0-28	3.89[b]	3.48[a]	4.10[b]	.25
0-28 (conc)	3.89[c]	3.48[b]	2.73[a]	.21
28-159	6.80	6.53	6.59	.31
0-159[a]	6.50[b]	6.12[a]	6.31[ab]	.26
0-160[b]	6.59[b]	6.16[a]	6.47[b]	.23
Determined ME	2.94[a]	3.06[b]	2.97[a]	.071
Sickness				
Days, mean	3.2[b]	1.9[a]	1.7[a]	.94
Incidence,%	86	76	79	12.4
Duration, days	3.7[b]	2.5[a]	2.1[a]	1.0

[abc]Means in a row with different superscripts differ statistically ($P<.05$).
[d]Based on full live weight.
[e]Based on carcass weight/.62.
[f]After subtraction of extra roughage.

Incidence of sickness tended to be lowest for cattle fed thiopeptin. Control cattle fed the high concentrate ration from the start of the trial were more likely to be sick for a longer period than cattle fed the other two rations.

Carcasses of cattle abruptly fed the high concentrate ration were lighter (P<.05) in weight (Table 3) and tended to have a greater incidence and severity of liver abscesses. Muscling reflected carcass weight differences though internal and external fat tended to be lower for cattle started on the high roughage ration.

Performance of cattle subdivided by weight groups is presented in Table 4. Feed intake and rate of gain increased with initial weight. For every 100 pounds increased initial weight, feed intake increased by 2.4 pounds per day (P<.01) and rate of gain for the trial increased .27 pounds per day (P<.01). The weight spread between groups increased as the trial progressed from an initial difference of 99 lb to a final spread of 137 lb. Daily feed intake, as a percentage of body weight, progressively declined with increase in body weight from 2.43 to 2.36 percent of body weight. Nevertheless, feed intake was predicted well using the gain projection formulas derived by Gill (1979). Feed efficiency was slightly better for the lighter than heavier groups of calves. Carcass weights were greater for calves which started the trial heavier, but dressing percentages were not different among weight groups (Table 5). Measured rib eye area increased with carcass weight. For every 100 lb increase in hot carcass weight, rib eye area increased 1.5 square inches (P<.01). Rib eye area expressed per unit of carcass weight, however, decreased as carcass weight increased. Rib eye area per hundred pounds of carcass decreased by .07 square inches with a carcass weight increase of 100 pounds. Grade tended to increase with carcass weight (P<.06).

A previous trial (Gill *et al.*, 1979) with continuous thiopeptin feeding demonstrated a 5.3 percent benefit in rate of gain and 7.8 percent in feed efficiency. This compares with 7.9 and 6.5 percent respectively in this trial (Figures 1 and 2). Marked similarity of results from the two trials both in gain and efficiency suggests that thiopeptin advantages were as great with 28-day feeding (1980) as continuous feeding (1979). In both trials, most of the performance and efficiency advantage was observed during the first month on feed.

Table 3. Carcass characteristics with thiopeptin feeding

Item	Control	Thiopeptin	Regular	LSD
Carcass weight, lb	623[a]	644[b]	643[b]	13.1
Dressing percentage	61.6	61.8	61.3	.96
Abscess				
Incidence, %	40.5	21.4	31.0	24.1
Severity[c]	.79	.36	.50	.49
Rib eye area				
Square inches	11.89[a]	12.24[b]	12.41[b]	.29
In.^{2}/100 lb carcass	1.92	1.91	1.93	.42
Fat thickness over rib, in.	.58	.64	.58	.102
Kidney-heart-pelvic fat, %	3.12	3.13	3.07	.25
Marbling score[d]	15.2	15.3	14.2	1.15
Federal grade[e]	12.9	12.9	12.9	.24
Cutability, %[f]	49.5	49.3	49.8	.76

[ab]Means in a row with different superscripts differ statistically (P<.05).
[c]No abscess = 0; one small abscess = 1.
[d]Small = 13; small plus = 14.
[e]Good plus = 12; choice minus = 13.
[f]From standard formula.

Table 4. Performance by weight group

Item	Weight group 1	2	3	4	5	6	LSD
Pens	3	3	3	3	3	3	
Steers	21	21	21	21	21	21	
Weight, lb							
Initial	514^{a}	537^{b}	549^{c}	566^{d}	583^{e}	613^{f}	3.3
28 days	631	659	679	689	705	739	
159 days^{g}	973	998	1024	1035	1068	1108	
160 days^{h}	964^{a}	993^{b}	1016^{bc}	1030^{cd}	1056^{d}	1101^{e}	29.9
Daily gain, lb							
0-28	4.16	4.35	4.67	4.38	4.34	4.47	.572
28-159^{a}	2.81^{a}	2.78^{a}	2.82^{a}	2.84^{a}	2.98^{b}	3.03^{b}	.122
0-159^{a}	2.87^{a}	2.88^{ab}	2.97^{abc}	2.94^{ab}	3.03^{bc}	3.09^{c}	.150
0-160^{b}	2.81^{a}	2.85^{ab}	2.92^{abc}	2.90^{abc}	2.96^{bc}	3.05^{c}	.160
Feed intake, lb DM/day							
0-28	15.4^{a}	16.6^{ab}	17.0^{ab}	17.0^{ab}	16.5^{ab}	18.2^{b}	1.81
28-159^{a}	18.1^{a}	18.6^{ab}	19.0^{ab}	18.9^{ab}	19.6^{bc}	20.2^{c}	1.10
0-159^{a}	17.6^{a}	18.3^{ab}	18.7^{ab}	18.6^{ab}	19.1^{bc}	19.8^{c}	1.02
Projected^{i}	18.2	18.6	18.8	19.0	19.3	19.7	
Feed/gain							
0-28	3.71	3.82	3.66	3.88	3.81	4.05	.35
28-159^{a}	6.46	6.69	6.74	6.67	6.59	6.67	.44
0-159^{a}	6.16	6.34	6.30	6.34	6.30	6.42	.37
0-160^{b}	6.28	6.42	6.40	6.40	6.44	6.50	.32
Metab. energy, mcal/kg	2.95	2.95	2.97	3.00	3.02	3.05	.10
Sickness							
Sick days, mean	1.8	2.6	2.1	2.0	2.6	2.4	1.5
Incidence, %	71	76	86	81	81	86	17.5
Duration, days	2.3	3.4	2.4	2.5	3.2	2.8	1.3

^{abcdef}Means in a row with different superscripts differ statistically ($P < 1.05$).
^{g}Based on full live weight.
^{h}Based on carcass weight /.62.
^{i}Based on equation of Gill (1979).

Table 5. Carcass characteristics by weight group

Item	Weight group						
	1	2	3	4	5	6	LSD
Carcass weight, lb	598[a]	616[b]	629[bc]	638[cd]	655[d]	683[e]	18.5
Dressing percentage	61.5	61.7	61.5	61.7	61.4	61.6	1.35
Abscess							
Incidence, %	29[ab]	52[b]	10[a]	43[ab]	19[ab]	33[ab]	34.2
Severity[f]	.57	.76	.24	.71	.38	.62	.69
Rib eye area							
Square inches	11.7[a]	11.9[a]	11.9[a]	12.0[a]	12.5[b]	13.1[c]	.41
in 2/cwt carcass	1.97[c]	1.94[bc]	1.89[ab]	1.87[a]	1.91[ab]	1.91[ab]	.06
Fat thickness over rib, in.	.59	.63	.61	.60	.58	.61	.144
Kidney-heart-pelvic fat, %	3.07	3.02	3.24	3.02	3.14	3.14	.35
Marbling score[g]	15.0[ab]	14.2[a]	13.8[a]	14.0[a]	16.2[b]	16.4[b]	1.63
Federal grade[h]	12.8[ab]	12.8[ab]	12.7[a]	12.9[ab]	12.9[ab]	13.1[b]	.35
Cutability, %[i]	49.6	49.4	49.3	49.4	49.7	49.7	1.07

[abcde]Means in a row with different superscripts differ statistically (P<.05).

[f]No abscess = 0; one small abscess = 1.

[g]Small = 13; Small plus = 14.

[h]Good plus = 12; choice minus = 13.

[i]From standard formula.

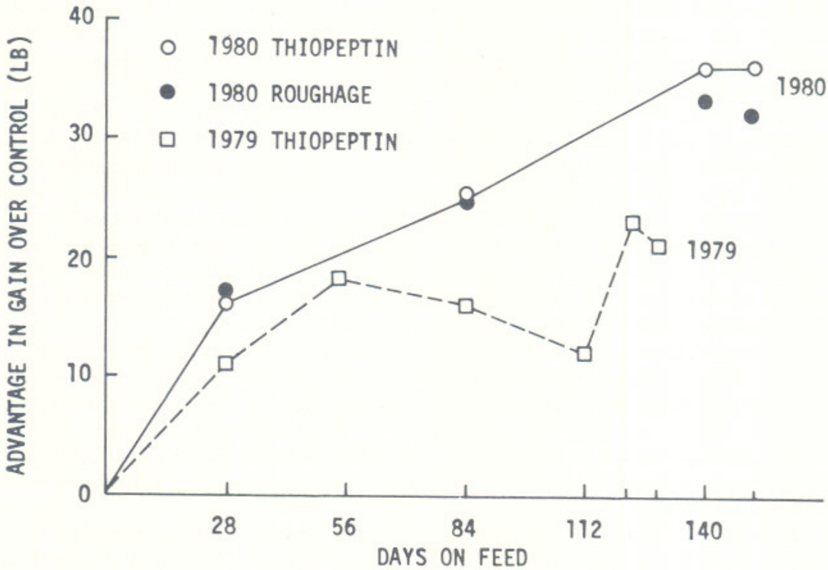

Figure 1. Cumulative gain effects.

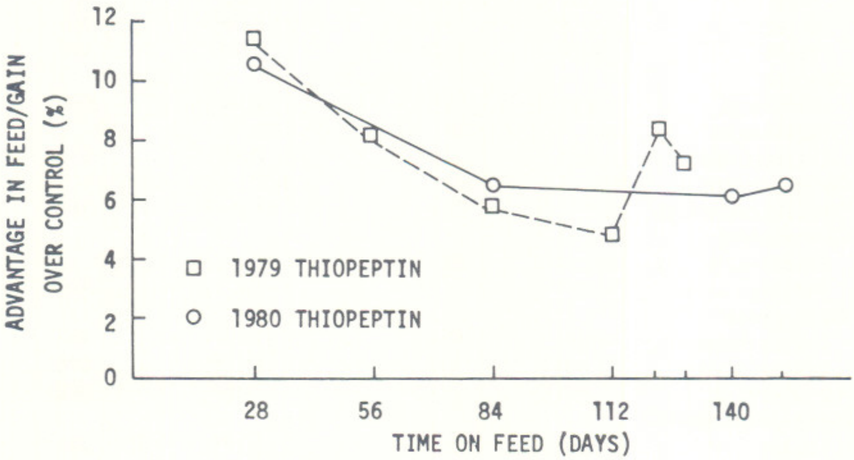

Figure 2. Cumulative feed efficiency effects.

Performance and carcasses of cattle fed a high concentrate ration with thiopeptin were very similar to those of cattle started on a roughage ration and gradually switched to a high concentrate ration. This suggests that thiopeptin might be considered a substitute for roughage. Thiopeptin rations are generally simpler to prepare and handle than roughage rations and with equal cost of gain and feed efficiency, most feedlot managers would prefer feeding thiopeptin to feeding roughage.

In both the 1979 and 1980 trials, the number of sick days was reduced with thiopeptin feeding. Incidence and severity of liver abscesses tended to be lower with thiopeptin feeding in this trial though this was not observed in the previous trial (Gill *et al.*, 1979). Health benefits during the early part of a feeding trial may be responsible for much of the benefit from thiopeptin feeding. Comparison of the health of cattle started on roughage with those started on the high concentrate ration without thiopeptin suggests that large intakes of concentrate are associated with sickness in newly received cattle. If cattle are not fed a well processed high energy ration or are not consuming large amounts of feed, thiopeptin might appear to be ineffective.

Performance and carcass characteristics subdivided by breed are presented in Table 6. Angus steers generally had slower gains, greater sickness (but not liver abscesses) and carcasses with less muscling and more fat. Heterosis in gain uncorrected for initial weight was 5.6 percent. Most other values were approximately midway between parental breeds. Incidence of sickness suggests that the Angus steers used in this trial were more susceptible to sickness and thereby may have been more responsive to thiopeptin feeding.

Effectiveness of thiopeptin for starting cattle on feed raises several questions. First, are thiopeptin effects cumulative with 1) estrogenic implants, 2) antibiotics in feed and

Table 6. Performance by breed of steers fed

	Breed			
Item	**Angus**	**Hereford**	**Angus x Herford**	**LSD**
Daily gain, lb				
0-28	4.23	4.53	4.41	.45
28-160	2.75[a]	2.85[ab]	2.98[b]	.20
0-160	2.80[a]	2.88[ab]	3.00[b]	.16
Sickness				
Mean days	3.1[b]	1.5[a]	2.1[a]	.96
Incidence,%	89	78	76	19
Duration, days	3.5[b]	2.0[a]	2.8[a]	.91
Carcass weight, lb	630	636	640	—
Dressing percentage	61.7	61.2	61.5	.78
Liver abscess				
Incidence, %	25	39	30	20
Severity	1.7	1.9	1.6	.40
Rib eye area				
Square inches	11.9[a]	12.5[b]	12.2[ab]	.50
in 2/cwt carcass	1.89[a]	1.97[b]	1.91[ab]	.076
Fat over rib, in.	.65[b]	.52[a]	.63[b]	.082
Kidney-heart-pelvic				
fat, %	3.3[b]	3.0[a]	3.1[ab]	.22
Marbling score	15.3	14.3	15.1	1.30
Federal grade	12.9	12.8	12.9	.2
Cutability	49.0[a]	50.3[b]	49.4[a]	.70

[ab]Means in a row with different superscripts differ statistically ($P < .05$).

3) monensin supplementation? Secondly, what would the relative economics of thiopeptin versus roughage feeding show? Third, might addition of thiopeptin to preconditioning and sale barn rations help prevent stress and shipping fever of cattle? Fourth, is feeding of all concentrate rations feasible with thiopeptin? Potential benefits would be expected since roughages normally depress intestinal starch digestion and reduce efficiency use. Finally, health of newly received cattle deserves further attention to determine why ruminal or intestinal damage reduces later performance. If the magnitude of carryover effects is quantitated, livestockmen may pay more attention to this critical period.

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Corn Silage Ammoniation Time and Protein Solubility

F. N. Owens, W. M. Sharp and George Davis[1]

Story in Brief

Chopped corn plants (27 to 34 percent dry matter) were ensiled with addition of ammonia at various times following chopping. Insoluble crude protein content was increased by ammonia addition. Delaying ammonia treatment for up to 4 hours after chopping did not greatly reduce the effect of ammoniation on protein solubility. Addition of urea had effects on protein solubility similar to ammonia addition with higher recovery of added protein.

Introduction

In freshly chopped corn plant material, only a small proportion of the protein is in a soluble form. In silage, 40 to 80 percent of the protein (nitrogen) is soluble. The chance for ruminal bypass of soluble protein is small, and protein bypass for ruminants is generally desirable. In research conducted at Michigan State, protein solubilization has been attributed primarily to continued action of plant enzymes the first few hours after harvest. Therefore, if plant enzymes can be inhibited, the protein value of corn silage for cattle should be improved. Since ammonia will inhibit plant enzymes rapidly, ammonia treatment of corn silage, besides providing an economical source of nitrogen, may improve the protein value of corn silage. If rapid inhibition of plant enzymes is desired, it may be necessary to treat silage immediately after chopping. The objectives of these two laboratory trials were to test the effects of 1) ammonia treatment at various times after chopping and 2) various nitrogen sources and levels and energy addition on protein solubility of corn silage.

[1]Kansas Agricultural Experiment Station, Garden City.