Potassium Levels and Ionophores for Feedlot Steers

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Story in Brief

Five level of potassium (.43 to 1 percent of diet dry matter) were fed with monensin or lasalocid (30 g/ton) to 140 yearling steers for 150 days. Steers weighed 731 lb at the start of the trial and were fed a 95 percent concentrate diet with 5 percent cottonseed hulls for roughage. During the early part of the trial, potassium supplementation tended to increase rate of gain. But over the total trial, potassium supplementation at moderate levels (.70 to .85) tended to reduce feed intake and significantly decreased energy intake and rate of gain. Feed efficiency was unchanged by potassium level. Potassium levels in the .7 to .85 range decreased carcass weight, but had no effect on other carcass measurements. No effects of potassium on ruminal acid levels or ammonia concentration were apparent, but with higher potassium levels, rumination was less frequent.

Steers receiving monensin and lasalocid (30 grams per ton) had similar rates and efficiencies of gain though cattle fed lasalocid consumed slightly more feed during the first month on feed. The ruminal and carcass measurements for steers receiving the two ionophores were not different.

Introduction

The estimated requirement for K for feedlot steers is .6 to .8 percent (NRC, 1976). Newly received cattle usually regain weight lost during shipment more rapidly when the diet contains higher levels of K (Hutchinson, 1980) though this effect often disappears when cattle are fed for longer than 56 days. Supplemental K increases the extent of fiber and starch digestion in the rumen (Zinn and Owens, 1980) and supplementation to a level of 1 percent of the diet has increased weight gain or feed efficiency in two previous trials. Since ionophores interact with Na and K, the need for and benefit of K supplementation of diets containing monensin or lasalocid needs to be reassessed. The objective of this trial was to determine the optimal level of K supplementation of diets containing ionophores.

Materials and Methods

One hundred forty yearling crossbred steers with an initial weight of 732 lb were trucked 99 miles from Purcell, OK on May 21, 1982 for feeding in Stillwater. Steers were ear tagged and randomly alotted to 20 pens with 7 steers

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Table 1. Diet composition.

Ingredient	Percent of Dry Matter
Corn grain	89.4
Cottonseed hulls	5.0
Supplement[a]	5.6
Cottonseed meal	3.26
Limestone	1.18
Urea	.45
Salt	.32
Dicalcium phosphate	.31
KCl[b]	0-1.03
Premix[c]	.08

[a]Not pelleted for first 69 days of trial; pelleted thereafter.
[b]To provide dietary K levels of .43, .55, .70, .85 and 1% of diet dry matter. KCl replaced corn grain at levels of 0, .22, .48, .76, and 1.03% of the diet.
[c]To provide vitamin A (2043 IU/lb of feed), trace minerals (.5 lb/ton), and monensin or lasalocid (30 g per ton of feed). Actual assays of ionophore levels are shown in Table 1A.

per pen following vaccination for IBR-BVD-P13 and blackleg. The final 5 percent roughage diet (Table 1) was diluted with cottonseed hulls to a level of 40 percent roughage for 3 days, 30 percent roughage for 3 days, 20 percent roughage for 2 days and 12.5 percent roughage for 2 days. The diets provided 5 different levels of potassium (.43, .55, .70, .85 and 1 percent of dry matter) with monensin or lasalocid at a level of 33 ppm (Table 1-A).

Steers were weighed shrunk initially and without feed and water restriction on days 21, 56, 84, 112 and 140 of the trial. On day 150, steers were trucked to Dodge City, KS, and slaughter and carcass data were obtained. Rumen fluid samples were obtained by stomach tube from two steers per pen on day 117 of the trial and analyzed for volatile fatty acid percentages, and ammonia-nitrogen. On day 144, feeding, lying and ruminantion behavior were monitored at 30 min intervals for 24 hours and fecal samples were obtained from 4 to 6 animals in each pen.

Table 1A. Bovatec and Monensin Assay results.

Potassium level	Drug level	Found on Assay[1]	
	g/ton theory	Bovatec	Monensin
.43	30	26.8	27.9
.55	30	24.9	30.9
.70	30	25.2	26.6
.85	30	27.1	26.3
1.00	30	25.9	30.2

[1]Grams per ton.

Table 2. Performance of Steers fed various K Levels

	K Level, % of dry matter				
Weights, lbs.	.43	.55	.7	.85	1
Initial	730	735	731	722	741
21 days	827	836	838	811	844
56 days	902	904	905	869	903
85 days	1018	1001	989	982	1006
112 days	1078	1052	1041	1035	1074
128 days	1143	1128	1107	1110	1143
131 days	1163	1139	1131	1119	1165
Total gain	433	404	400	397	424
Daily gain, lbs/day					
0-21 day	2.65	2.84	3.08	2.34	2.89
0-56 day	2.26	2.21	2.3	1.85	2.08
57-140 day[a]	2.73	2.53	2.28	2.73	2.72
0-140 day	2.55	2.4	2.29	2.38	2.46
0-150 day[a]	2.92	2.72	2.68	2.64	2.78
Daily feed, lbs/day					
0-56 day	20.64	19.73	18.82	19.12	19.49
57-140 day	22.36	21.68	21.14	21.5	21.78
0-140 day[a]	21.56	20.79	20.05	20.51	20.74
0-150 day	21.71	20.95	20.28	20.61	20.93
Feed/Gain					
0-56 day	9.1	9	8.2	10.78	9.57
57-140 day	8.25	8.61	9.28	7.92	8.02
0-140 day	8.51	8.67	8.75	8.74	8.44
0-150 day	7.47	7.71	7.58	7.8	7.52
Met Energy content of feed mcal/kg	2.79	2.76	2.79	2.72	2.81
ME Intake mcal/day[a]	27.5	26.2	25.7	25.5	26.7

[a]Quadratic effect of K level ($P < .05$).

Results and Discussion

No interaction of potassium level and type of ionophore was evident. Effects will be discussed separately below. Potassium supplementation tended to increase live weight gain during the first 21 days of the trial (Table 2). This agrees with the short-term benefits of K supplementation for newly received cattle reported by Hutchinson (1980). Such response may be due to increased fluid retention in the gut or in tissues as suggested previously (Zinn et al, 1982). During the remainder of the trial, potassium supplementation reduced feed intake and rate of gain with little effect on feed efficiency of metabolizable energy content of the diet. Results do not match with previous suggestions (Zinn et al, 1982) of benefits of K supplementation in which steers or heifers received KC1 to provide 1 percent of K in the diet. In those shorter trials, supplemental K increased rate of weight gain and feed efficiency. An increase in ruminal

digestion with KC1 supplementation, possibly through buffering action (Zinn and Owens, 1980), may prove more beneficial when diets contain a more digestible fiber source than cottonseed hulls as were used in this experiment.

Sorting of fine particles from the feed was observed with the higher KC1 levels prior to the time the supplement was pelleted. This may be due to the bitterness of KC1. Potassium at 0.85 percent of the diet depressed feed intake and gain to the greatest degree, but calculated metabolizable energy content of the diet was not reduced as drastically (3 percent) as energy intake (7 percent).

Ruminal, fecal and carcass characteristics of steers, except for carcass weight, were not influenced by K supplementation (Table 4). The reduced carcass weight of steers fed middle levels of K reflects the pattern of reduced feed intake for these steers mentioned previously. Animal behavior appeared to be slightly altered by potassium level. Though eating and laying times were not

Table 3. Performance of Steers fed Monensin or Lasalocid

	Monensin	Lasalocid
Weights, lbs.		
Initial	726	738
28 days	822	841
56 days	891	902
85 days	991	1006
112 days	1048	1062
128 days	1116	1135
131 days	1134	1152
Total gain	408	414
Daily gain, lbs/day		
0-21 day	2.62	2.92
0-56 day	2.14	2.13
57-140 day	2.54	2.64
0-140 day	2.39	2.43
0-150 day	2.73	2.75
Daily feed, lbs/day		
0-21 day	18.02	18.26
0-56 day	19.59	19.42
57-140 day	21.54	21.8
0-140 day	20.65	20.74
0-150 day	20.81	20.91
Feed/Gain		
0-56 day	9.37	9.31
57-140 day	8.53	8.31
0-140 day	8.69	8.56
0-150 day	7.65	7.6
Met Energy content mcal/kg	2.76	2.79
ME Intake mcal/day	26.1	26.4

Table 4. Ruminal and Carcass Characteristics of Steers Fed Various Potassium Levels

K, % of DM	.43	.55	.7	.85	1
Ruminal VFA concentrations, mM/1					
Total	75.4	71.2	72.2	64.3	76.4
Acetate %	44.8	44.3	48	47.3	46.4
Propionate %	49.7	46.8	43.9	42.9	46
Butyrate	5.5	8.8	9	10.8	7.8
Ruminal ammonia mg/dl	6.5	7.9	6.9	6.8	6.9
Carcass wt.[a]	721	706	701	694	722
Dress %	61.8	61.8	61.9	60.7	61.4
Rib eye area					
Sq. inches	12.0	12.1	11.9	12.3	12.2
In/cwt	1.68	1.73	1.71	1.78	1.7
Rib fat	.42	.42	.43	.36	.39
Fed grade	13	12.9	13.4	12.8	12.8
% choice	48	39	61	39	36
Yield grade	2.79	2.45	2.86	2.61	2.7

[a]Quadratic effect of K level ($P < .01$).

Table 5. Ruminal and Carcass Characteristics of Steers fed Monensin or Lasalocid

	Drug	
	Lasalocid	Monensin
Ruminal VFA concentrations, mM/1		
Total	72.3	71.2
Acetate %	46.3	46.2
Propionate %	44.7	46.5
Butyrate %	9.1	8
Ruminal ammonia mg/dl	7.6	6.5
Carcass #	714	703
Dress %	61.4	61.6
Rib eye area		
Sq. inches	12.3	11.9
In/cwt	1.73	1.71
Rib fat	.39	.41
Fed grade	13	13
% choice	44	44
Yield grade	2.69	2.66

Table 6. Animal behavior and fecal measurements with various dietary K levels.

	K level				
	.43	.55	.70	.85	1.00
Percentage of total time					
Eating	8.1	8.2	9.2	8.2	8.5
Laying	45.8	49.1	51.5	47.6	45.8
Ruminating[a]	9.4	5.7	7.5	5.5	4.9
Fecal DM, %	28.4	25.9	25.6	27.6	26.2
Fecal starch, %	22.4	24.2	19.0	22.1	19.8

[a]Significant decrease in rumination with added K.

altered, incidence of rumination was reduced by almost half by added K (Table 6). If steers eat more slowly and frequently when K is added to the diet as suggested previously (Zinn et al, 1982), they may chew their feed more thoroughly when eating, reducing the need for later rumination of whole corn particles. But the eating behavior in this trial does not support this suggestion. Differences in composition of feces were nonsignificant.

Differences over the total trial attributable to monensin or lasalocid feeding were very small (Table 3). During the first 21 days, however, gain was 12 percent greater and feed intake was about 1.5 percent more for steers fed lasalocid than steers fed monensin. For the total 150 days, lasalocid fed steers had less than 1 percent advantage in rate of gain and efficiency of feed use. Ruminal, fecal and carcass measurements (Table 5) and animal behavior (Table 7) did not differ with source of ionophore in the diet.

Table 7. Animal behavior with various ionophores.

	Monensin	Lasalocid
	Percentage of total time	
Eating	9.1	7.7
Laying	49.2	46.7
Ruminating	6.8	6.4
	Fecal parameters, %	
Dry matter	26.0	27.5
Starch	19.3	23.1

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