EFFECT OF SUPPLEMENTAL POTASSIUM ON SUMMER PERFORMANCE OF COMMERCIAL FEEDLOT STEERS

B.E. Doran[1], F.N. Owens[2], S.L. Armbruster[3] and D. Schmidt[4]

Story in Brief

Red and white-bodied crossbred steers in a commercial feedlot were fed three levels of dietary potassium [.77 (basal), .89 and 1.01% of diet dry matter] during 42 to 56 days of late summer to check effects on heat stress and performance. Four groups of uniform steers were subdivided into 4 pens (a total of 787 steers) fed .77 and .89% potassium while 3 pens (300 steers) received the 1.01% dietary potassium. Daily gain, feed consumption and feed efficiency tended to be improved with supplemental potassium. Cost per pound of gain, cost per head per day, respiration rates, and body surface temperatures were not significantly affected by treatment. Increasing the dietary potassium level above 0.77% of diet dry matter for summer feeding of finishing steers did not significantly alter metabolism or performance of steers. Summer temperatures were generally mild during the study which may have biased the results of this trial. Further research to assess the effect of supplemental potassium upon the performance of heat stressed feedlot steers is warranted.

(Key Words: Potassium Chloride, Heat Stress, Respiration Rate, Body Surface Temperature, Feedlot Steers.)

Introduction

Currently, the National Research Council recommends a dietary potassium level of .65% for beef cattle. Feedlot diets containing high levels of grain often require potassium supplementation. In addition, severe heat stress has the potential (Beede et al., 1983) to increase potassium loss through sweating. Heat-stressed feedlot steers exhibit reduced feed intake and weight gain. Potassium deficiency can decrease feed intake and rate of gain, but specific deficiency symptoms are not readily apparent. Thus, the heat stressed feedlot steer may be potassium deficient.

Milk production by dairy cows, under the stress of high environmental temperatures, has been increased with supplemental potassium. Feed intake and milk yields were both increased (Beede et al., 1983). Work with steers has been less favorable (Beede et al., 1985). Survival of heat-stressed broilers also can be increased with higher potassium intake (Smith and Teeter, 1986). Most studies showing benefits to elevated potassium intake by finishing cattle have been conducted during the summer.

The objective of this trial was to examine the effect of supplemental potassium upon the performance of commercial feedlot steers during the late summer.

[1]Graduate Assistant [2]Professor [3]Nutrition Consultant, Stillwater [4]Manager, Brookover Feedlot, Garden City, KS.

Materials and Methods

One-thousand-eighty-seven crossbred steers of 4 groups with similar initial weight, background, and ownership were placed in 11 commercial feedlot pens containing 44 to 134 steers per pen. Pens were located near Garden City, Kansas and were equipped with a tear drop waste disposal system. When the environmental temperature exceeded 80 degrees Farenheit, a sprinkler system automatically switched on for 5 minutes each half hour.

The trial began July 24, and the cattle were slaughtered from September 5 to September 19, 1985. Three diets (Table 1) were fed. The basal diet contained no supplemental potassium but by calculation provided .6% potassium. The other two diets were formulated to contain .8 or 1.0% potassium from supplemental KCl added to the ration in a slurry delivered from a micro-ingredient machine. Samples of the ration were analyzed, and the potassium content was determined to be .77, .89 and 1.01% of dry matter for the three diets. The analyzed values of potassium between diets were closer than expected from calculated values based on the amount of potassium added. Commercial analysis showed similar values.

On September 6 at 1:30 and 4:30 pm heat stress was checked. Respiration rates and surface temperatures of seven to fifteen steers per pen were monitored as described by Arp et al. (1983).

To calculate initial and final mean weights from full pen weights, a 4% pencil shrink was applied. All animal performance calculations were based upon these values. Data were subjected to analysis of variance using the Statistical Analysis System, and Duncan's Multiple Range test was used to separate means. Linear and quadratic effects of treatments were checked using the general linear model of the Statistical Analysis System.

Table 1. Composition of basal finishing ration.

Ingredient	Percent of dry matter
Alfalfa-stover[a]	4.86
Corn silage	2.10
Supplement	4.86
Corn hominy	11.30
Wheat, dry rolled	30.60
Corn, high moisture	42.42
Fat blend[b]	3.80
Micro-ingredients[c]	---

[a]Blend of 75% alfalfa hay and 25% milo stover.
[b]Blend is 70% vegetable oil and 30% animal fat.
[c]To provide dietary potassium levels of .77, .89 or 1.01% from addition of potassium chloride at 0, 6.1 or 12.2 pounds per ton of feed.

Results and Discussion

All pens of steers had mean daily gains exceeding three pounds per day, and differences between treatment groups were small. Average daily gain (Table 2) for the total feed period tended to be increased with added potassium. Gains of the steers fed the two higher levels of potassium were almost identical (3.11 and 3.12 lb per day). This conflicts with research from Florida (Beede et al., 1985) in which gains tended to decrease when potassium level in the diet increased above .65%. Elevated potassium intakes can increase live weight gain of broilers by 46% under severe and chronic day-night heat stress.

Most of the increase in the gains of the steers receiving the supplemental potassium is attributable to increased feed consumption. Steers receiving the two higher potassium levels consumed 1.6% more feed than steers fed the basal diet. In other research, increasing potassium from .66 to 1.08% of the ration increased feed intake by heat stressed lactating dairy cows. In a Florida trial with beef steers, in contrast, increasing potassium from .7 to 1.1% of the diet decreased feed consumption by 2.5%.

Feed efficiency of the steers tended to be improved, with a .3% increase with each increment in the level of dietary potassium. Potassium supplementation has increased the feed efficiencies of severely heat stressed broilers by 15.4%. With yearling steers fed during the summer with cycling temperature stress, feed efficiencies tended to be decreased by .83% with dietary potassium levels of 1.1% in one trial. Whether the duration of the heat stress (i.e., chronic vs cycling temperature) impacts the potassium response is not known.

Feed cost per pound of gain was similar between steers consuming the .89 and 1.01% potassium diets. Feed cost per pound of gain for the steers fed the basal diet was .06 to .07 cents lower which may be attributed to the differences in feed efficiency noted earlier. If K loss increases with heat stress, one would expect that cellular hydration and thereby feed efficiency could be altered. Cost per head per day included feed and yardage expenses. The cost tended to increase with the steers receiving supplemental potassium due to increased feed consumption by steers fed the higher levels of potassium.

Under ambient environmental temperatures, the respiration rates of a dairy cow standing at rest or laying are approximately 29 and 35 respirations per minute, respectively. Respiration rate increases under heat stress. Rates of 130 respirations per minute have been noted in lactating dairy cows under unshaded conditions, and treatment means

Table 2. Animal performance of steers fed three dietary levels of potassium.

Item	K level, percent of dry matter		
	.77	.89	1.01
Daily gain, lb/day	3.05	3.11	3.12
Daily feed consumption, lb/day	20.03	20.36	20.37
Feed/lb gain	6.62	6.60	6.58
Cost/lb gain, cents	49.61	49.55	49.54
Cost/head/day, dollars	1.50	1.53	1.54

Table 3. Physical measurements of steers fed three dietary levels of potassium.

Item	K level, percent of dry matter		
	.77	.89	1.01
Respiration rate, 1:30 pm	79	77	76
Respiration rate, 4:30 pm	67	69	67
Body surface temperature 1:30 pm, Degrees Farenheit	104	101	101
Body surface temperature, 4:30 pm, Degrees Farenheit	101	101	104

reported by Arp et al. (1983) approached 140 breaths per minute. Increased "panting" may reduce blood pH and indirectly reduce the buffering properties of saliva which lowers ruminal pH. In addition, panting may contribute to a salivary loss of up to 40 pounds per day, resulting in a loss of 1.8 to 2.9 ounces of minerals.

Respiration rates of the steers in the current trial were elevated above the normal range but were not as high as expected during a very hot, sunny day. The high temperature reached day of measurement was 96 degrees Farenheit; the low temperature was 56 degrees. Relative humidity was 71%. Respiration rates of the steers did not change with the level of dietary potassium.

No significant differences in body surface temperatures of the steers were detected. Unlike respiration rates, body surface temperatures did not decline at the 4:30 pm observation. Added potassium may have reduced heat load slightly which in turn allowed feed intake to increase which resulted in similar respiration rates and surface temperatures.

Results from this trial indicate that metabolism and performance of the feedlot steers was not significantly improved by elevated levels of potassium. However, the trial began relatively late in the summer, and summer temperatures were much milder than normal (Table 4). Further research needs to be conducted under more severe environmental temperatures to further examine the effect of supplemental potassium on heat-stressed feedlot cattle.

Table 4. Climatic measurements during the trial.

Month	Temperatures		Relative humidity
	Average high	Average low	
July	92.0	63.3	79
August	87.2	60.2	88
September	78.0	52.1	88

Literature Cited

Arp, S.C., et al. 1983. Relationships of coat color, body surface temperature and respiration rate in feedlot steers. Okla. Agr. Exp. Sta. Res. Rep. MP-114:82.

Beede, D.K., et al. 1983. Potassium nutrition and the relationship with heat stress in lactating dairy cattle. Presented at the Sixth Annual Minerals Conference, St Petersburg Beach, FL.

Beede, D.K., et al. 1985. Effect of supplemental potassium and sodium on the feedlot performance of yearling steers fed during the summer. Florida Beef Cattle Research Report:79.

NRC. 1984. Nutrient requirements of beef cattle. Sixth revised edition. National Academy of Sciences.

Smith, M.O. and R.G. Teeter. 1986. Personal communication.