EFFECT OF SUPPLEMENTAL POTASSIUM AND BUFFER IN STARTERS FOR EARLY-WEANED CALVES

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Summary

Sixty Holstein heifers were used from birth to 8 weeks of age to study the effect of amount of potassium (K) in the diet and of adding a buffer to the starter. Starters were formulated with and without 1% trona, a natural ore buffer, at K concentrations of .9, 1.25, and 1.5% of the dry matter. To supply adequate fiber, yet allow formulation of the starter containing .9% K, 20% prairie hay was included. All calves were fed milk and a prestarter, using an early weaning procedure. Growth and feed consumption data and evaluation of health and metabolic activity were used as response criteria. Overall, calves fed 1.25% K consumed the same amount, whether fed buffered or nonbuffered starter. At other K levels, calves fed nonbuffered starters consumed more. Growth of calves fed buffered starter with 1.5% K was depressed. Metabolic data supported the conclusion that this buffer was not beneficial with this type of starter. Increasing the amount of K did not significantly increase calf response, but there was a trend for gains to increase as K increased to 1.25% in both buffered and nonbuffered starters. Since these calves were not heat stressed, opportunity for maximum benefit from added K did not exist.

Introduction

Although potassium is the third most abundant mineral in the animal body and has many vital functions, little research has been done on the K requirements of calves. The National Research Council currently recommends K at .8% of ration dry matter for all dairy animals. Recent research suggests that K requirements of dairy cows are increased during hot weather. In general, forages are good sources of K, thus high roughage diets usually contain ample amounts, but high concentrate diets may benefit from supplemental K.

Using an early weaning program developed here at Kansas State, we have observed rapid development of rumen fermentation and a beneficial effect of addition of buffer to the starter ration. For years, sodium bicarbonate has been the buffer most commonly used in feeds for ruminants. Recently, several new buffers have become available for use. One of these is trona, a natural ore and thus economical, which is supposed to have characteristics similiar to sodium bicarbonate; however, little information is available concerning the use of this buffer in diets for dairy animals.

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The objective of this study was to determine the effects of different amounts of K and of use of trona in starter diets for early weaned dairy calves.

Procedures

Sixty Holstein heifer calves were used from birth until 8 weeks of age. They were balanced according to time of birth and assigned to one of six rations. The starter fed to half of the calves contained 1% of the trona buffer. The remaining calves were fed non-buffered starters. Within each group, the starters were formulated to contain either .9%, 1.25%, or 1.5% K, using potassium chloride and potassium sulfate to supply supplementary K. Other minerals were balanced equally as nearly as possible. To control composition of feed consumed, hay and concentrate were mixed together, and the resulting starter was pelleted. To allow formulation of the starters containing the lowest amount of potassium, it was necessary to limit the amount of alfalfa to 5%; prairie hay was used at 20% of the starter mixture.

After receiving colostrum for 3 days, all calves were fed milk at 8% of birth weight daily until 3 weeks of age in two daily feedings. For 1 week, they were fed milk once daily at 4% of birth weight, then weaned. To encourage them to eat dry feed, a prestarter[2] was provided until they consumed .5 lb prestarter daily, then .5 lb prestarter was mixed with all the starter they would consume each day until they were 6 weeks of age.

Daily feed consumption and weekly body weight gains were recorded. Fecal consistency scores and general appearance ratings were recorded twice daily. Blood samples were collected at 2, 3, 4, 6 and 8 weeks of age to allow evaluation of the metabolic status of the animals.

Results and Discussion

The amounts of weight gained and of feed consumed are shown in Table 1. Feed consumption and weight gains were depressed, compared to our usual results. This happened partly because the prairie hay, which was used because it was lower in K than alfalfa, was not as palatable as alfalfa. Overall, the amount of dietary K had no significant effect on weight gains or feed consumed when calves were fed the nonbuffered starters. There was a trend for weight gains to increase as K concentration in feed increased. Among calves fed buffered starters, those fed starters containing the most K gained the least. That group consumed less starter than calves fed the other levels of K, but the differences were not statistically significant.

After week 1, when starter consumption was very low, calves fed nonbuffered starter consumed more feed each week than calves fed buffered starter, with the differences being significant ($P<.05$) during weeks 6, 7 and 8 (Table 2).

[2]Calfweena, Merricks.

Fecal consistency scores were not affected by treatment (Table 1).

Results of analyses of blood samples are shown in Table 3. Treatments were without significant effect on blood pH, bicarbonate (HCO_3), CO_2 content, or base excess, and those values listed are within normal range. These data indicate that, in general, the calves were not experiencing metabolic stress and, therefore, buffer would be of less benefit.

Potassium concentrations of red blood cells (Table 3) decreased with age, but were not affected by amount of K in the feed.

Results of earlier studies have suggested that addition of buffer to calf starters would be beneficial, and earlier results here at Kansas State have suggested that this would be especially true in our early weaning program. It is known that buffers will be less beneficial in diets that contain more roughage than in low roughage diets. The diets that we fed contained 25% hay, thus reducing the need for a buffer. Apparently in this study, the starter was less palatable than starters usually used here, so feed consumption was lower, probably rumen fermentation was less active, and the need for a buffer was reduced. Thus, the lack of a beneficial effect of a buffer in this study does not suggest a general recommendation against use of buffers in calf starters.

Very few of the calves in this study were subjected to heat stress. Had that been the case, perhaps the higher concentrations of potassium would have been beneficial. The data are not conclusive in showing a K need greater than .8% of the dry matter. Most diets containing significant amounts of forages will supply more than this amount.

Table 1. Mean weekly weight gains, feed consumed, and fecal consistency scores[a]

Item	Nonbuffered Starter			Buffered Starter		
	1.5% K	1.25% K	.9% K	1.5% K	1.25% K	.9% K
Weight gain, lb	6.6 ± .13[c]	6.4 ± .13[c]	6.2 ± .13[bc]	5.7 ± .13[b]	6.6 ± .13[c]	6.4 ± .13[c]
Feed consumed, lb	16.9 ± .88[c]	16.1 ± .86[bc]	16.9 ± .88[c]	13.9 ± .95[b]	16.1 ± .95[bc]	15.2 ± .95[b]
Fecal score[d]	1.1 ± .04	1.1 ± .04	1.2 ± .04	1.2 ± .04	1.1 ± .04	1.1 ± .04

[a] Mean ± SE.
[b,c] Means within rows with unlike superscripts differ (P<.05).
[d] 1 = normal to 4 = watery.

Table 2. Effect on buffer on feed intake, (lb.)

Week	Nonbuffered Starter	Buffered Starter
1	1.32	1.32
2	1.98	1.76
3	4.62	4.4
4	9.46	8.8
5	19.1[a]	17.6[b]
6	27.7[a]	24.4[b]
7	31.9[a]	29.5[b]
8	37.2[a]	33.0[b]

[a,b]Means within a row with different superscripts differ ($P<.05$).

Table 3. Mean blood gas, pH, and red blood cell potassium concentrations

Item	Nonbuffered Starter			Buffered Starter		
	1.5% K	1.25% K	.9% K	1.5% K	1.25% K	.9% K
pH	7.371	7.372	7.372	7.372	7.373	7.370
pCO_2 (mmHg)	52.49	50.86	52.75	52.82	52.84	52.56
Base excess (meq/L)	4.55	4.18	4.87	4.84	4.89	4.48
HCO_3 (meq/L)	29.27	28.78	29.58	29.69	29.57	29.23
Red blood cell K (%)	.178	.188	.172	.179	.203	.174