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Yeast Culture in a Free-Choice Mineral Supplement for Stocker Cattle Grazing Wheat Pasture

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Story in Brief

Steer and heifer calves were grazed on wheat pasture from December to mid-March. Two groups were allowed access to a commercial mineral supplement, and two groups received the same supplement with added cultured yeast. The addition of 50-percent cultured yeast in the mineral mixture increased daily mineral consumption threefold from 0.08 to 0.24 lb per head.

The increased mineral consumption did not significantly ($P>.05$) affect the average daily gain of the cattle. However, limited available wheat herbage in one pasture replicate may have influenced these results. There was no difference in the calcium or magnesium status of blood or hair among the animals fed mineral alone or mineral with cultured yeast, but both appeared to be considerably below reported levels. Phosphorus levels were considered to be adequate. Herbage sodium was found to vary with pasture, and the sodium content of the hair but not serum of animals varied accordingly. Little treatment differences were found in herbage, serum or hair concentrations of potassium, iron, copper and zinc. Future studies with blood and hair samplings should involve a greater number of animals for a more sensitive statistical analysis.

Introduction

Early wheat pasture studies with grazing stocker cattle in the panhandle of Oklahoma indicated that there was a possible deficiency of calcium and magnesium (McMillen and Langham, 1942). Consumption of mineral supplements by cattle grazing wheat pasture has generally been relatively low. Mader *et al.* (1979) reported that steers grazing wheat pasture consumed only 0.26 lb per head daily of a 2:1 mixure of salt and limestone. A technique is needed to increase mineral consumption to meet calcium and magnesium requirements.

Ruf *et al.* (1953) showed that the inclusion of 5-percent live yeast in the diet of lambs increased feed consumption by 0.6 lb and daily gains by 0.16 lb. Feeding yeast

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would, therefore, appear to stimulate feed intake. It is also believed that yeast cells aid in utilization of excess ruminal ammonia by converting it to yeast cell protein (Stone, personal correspondence). Better utilization of ruminal ammonia, which is characteristically high in cattle grazing wheat pasture, should increase nitrogen balance and shift the microbial population from amylolytic to cellulolytic and, hence, increase fiber digestion.

The objectives of this trial were to determine if 1) cultured yeast would increase the voluntary consumption of a free-choice mineral supplement supplied for stocker cattle grazing wheat pasture and 2) the increased consumption of the cultured yeast and mineral supplement affected weight gains.

Materials and Methods

Steers (243 head) and heifers (259 head) with an average weight of 422 lb were allocated to two treatments with two pasture replicates per treatment. Replicates consisted of one group of steers and one group of heifers because of an insufficient number of one sex. Treatments were 1) free choice high-calcium, high-magnesium commercial mineral supplement[2] and 2) the same mineral supplement mixed with cultured yeast[3]. The mineral composition is shown in Table 1, and the nutrient composition of the cultured yeast is shown in Table 2. The mineral was mixed with cultured yeast at a ratio of 2:1 during the month of December and changed to 1:1 thereafter to increase total supplement consumption. The amount of supplement

Table 1. Mineral composition of mineral supplement and supplemental feed

Element	Mineral supplement	Supplemental feed
CA, %	16.40	0.62
Mg, %	7.70	0.12
P, %	4.20	0.55
Na, %	9.10	0.073
K, %	0.06	1.16
Fe, %	960	1622
Cu, %	20	16
Zn, %	360	56

Table 2. Nutrient composition of cultured yeast

Constituent	
DM, %	89.0
Crude protein, %	14.0
Crude fat, %	2.5
Crude fiber, %	8.0
Ash, %	4.0
Ca, %	0.28
Mg, %	1.02
P, %	0.71
Na, %	1.76
K, %	1.60
Fe, mg/lb	204
Cu, mg/lb	58
Zn, mg/lb	32

[2]Farmland Industries, Kansas City, Missouri.
[3]Diamond V Mills, Inc., Cedar Rapids, Iowa.

consumed was measured weekly. The stocking rate of each pasture was based on the amount of available wheat forage rather than on acreage *per se*.

The experiment was conducted on wheat pasture near Enid, Oklahoma, from the first week of December until the middle of March for a 100-day period. All pastures were fertilized in the fall with 100 lb of anhydrous ammonia per acre and with 90 lb of 10-30-0 applied to the two pastures on which the steers grazed.

All cattle also had access to a free-choice supplemental feed because of decreased growth of wheat forage resulting from limited fall precipitation. The mineral and ingredient composition of the supplemental feed are shown in Tables 1 and 3, respectively.

Samples of wheat herbage and cattle hair were obtained from eight head in each pasture at the initiation and completion of the trial. The samples were analyzed for calcium, phosphorus, magnesium, sodium, potassium, iron, copper and zinc by atomic absorption spectrophotometry as an indication of the animal's mineral status. Serum samples were also collected from the eight animals described above at the completion of the trial. Similar mineral analyses were conducted with the exception of phosphorus. The crude protein content of the herbage was also measured.

Results and Discussion

The mean daily consumption of mineral alone was 0.08 lb per head throughout the trial (Table 4). Daily consumption of mineral in the (2:1) mixture of mineral and cultured yeast was 0.14 lb per head. Consumption of the mineral in the mixture increased to 0.24 lb per head when the ratio of mineral to yeast was changed to 1:1.

Table 3. Ingredient composition of supplemental feed[1]

Ingredient	%
Ground shelled corn	20.0
Milo	32.0
Wheat middlings	21.0
Rice mill by-product	22.0
Molasses	5.0
	100.0

[1]Rumensen was added at level of 20 g/T.

Table 4. Mineral and cultured yeast consumption of cattle

Period	Mineral / Cultured yeast	Intake (lb/day) Mineral	Mineral +	Cultured yeast
Dec. 2 - Jan. 5	2:1	0.08^a	0.14^b	0.07^a
Jan. 6 - Mar. 15	1:1	0.08^a	0.24^b	0.24^b

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

Table 5. Performance and supplemental feed consumption of cattle

	Method of feeding mineral					
	Alone			With cultured yeast		
Pasture no.	1	2	X	3	4	X
Cattle sex	Steers	Heifers		Heifers	Steers	
No. cattle	100	143	122	116	143	130
ADG, lb/day	1.24	1.00	1.12^a	0.98	1.40	1.19^a
Supplemental feed, lb/day	0.41	0.43	0.42^a	1.48	0.84	1.16^b

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

There was no significant (P>.05) overall effect on average daily gain resulting from method of mineral feeding (Table 5). However, the low gain of the cattle on Pasture 3 was attributed to a reduced amount of available herbage as indicated by higher consumption of supplemental feed.

The mean calcium content of the herbage sampled in this study was 0.34 percent (Table 6). F. P. Horn *et al.* (1974) reported a similar wheat herbage calcium level of 0.42 in a report from the Southwestern Livestock and Forage Research Station at El Reno, Oklahoma. Both values are near the recommended dietary calcium level of 0.40 (N.R.C., 1976). The mean calcium content of the serum of all cattle involved in this study was 5.4 mg percent (Table 7). F. P. Horn *et al.* (1974) reported serum calcium levels of 5.8 mg percent. Both reports are considerably below the "normal" serum calcium values of 8.4 to 9.6 mg percent quoted by Stevens (1975) and 9.1 mg percent reported by McMillen and Langham (1942). The calcium content of the hair of cattle at the end of this study was 0.18 percent (Table 8), which is also lower than reported values of 0.2 to 0.3 percent (Combs *et al.*, 1979). There was no significant (P>.05) effect on the calcium content of the serum or hair resulting from method of feeding mineral.

The magnesium content of the pasture increased significantly (P<.05) from 0.20 in December to 0.25 percent in March (Table 6) and was above the N.R.C. requirement of 0.15 percent throughout the study. F. P. Horn *et al.* (1974) reported similar values of 0.25 percent magnesium in wheat pasture. The serum magnesium level was lower than the normal range of 1.8 to 2.4 mg percent reported by Stevens (1975). The magnesium content of the hair was also less than the 0.3 to 0.8 percent values reported by Combs *et al.* (1979). Methods of feeding mineral did not affect serum magnesium level (1.0 mg percent) or the magnesium content of the hair (0.10 percent).

Table 6. Crude protein and mineral composition of wheat pasture herbage dry matter

	Method of feeding mineral			
	Alone		With cultured yeast	
Pasture no.	1,2	1,2	3,4	3,4
Nutrient	12/1/79	3/9/80	12/1/79	3/9/80
Crude protein, %	25.0	30.0	26.5	30.2
Ca, %	0.34	0.32	0.32	0.36
Mg, %	0.20	0.24	0.19	0.26
P, %	0.38	0.55	0.43	0.52
Na, %	0.073[a]	0.075[a]	0.018[b]	0.020[b]
K, %	2.57	3.14	3.03	3.01
Fe, ppm	354[a]	1807[b]	413[a]	1490[b]
Cu, ppm	10	13	9	16
Zn, ppm	28	38	31	43

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

Table 7. Mineral composition of lamb blood serum on March 9, 1980

	Method of feeding mineral	
Element	Alone	With cultured yeast
Ca, mg %	5.9	4.8
Mg, mg %	1.0	1.1
Na, mg %	400	399
K, mg %	25.9	29.2
Fe, ppm	36.8	26.4
Cu, ppm	2.5	1.5
Zn, ppm	2.9	2.0

Table 8. Mineral composition of hair

Element	Method of feeding mineral			
	Alone		With cultured yeast	
	12/1/79	3/9/80	12/1/79	3/9/80
Ca, %	0.31	0.16	0.30	0.19
Mg, %	0.06	0.11	0.05	0.10
P, %	0.05	0.05	0.04	0.04
Na, %	0.18[a]	0.16[a]	0.15[a]	0.09[b]
K, %	0.07	0.06	0.06	0.04
Fe, ppm	288[a]	1863[b]	342[a]	1548[b]
Cu, ppm	8.9	12.40	9.4	11.70
Zn, ppm	142	140	136	137

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

The phosphorus content of the herbage increased from 0.40 in December to 0.54 percent in March (Table 6) and was above the N.R.C. requirement of 0.32 percent throughout the study.

The March herbage in the two pastures grazed by cattle that received mineral alone had significantly higher ($P<.05$) sodium (0.075 percent) than the herbage in the two pastures with cattle fed mineral and cultured yeast (0.020 percent - Table 6). The difference in herbage sodium content was not found in the serum (Table 7) as might be expected because of the homeostatic mechanisms present in the blood. However, the hair of cattle grazing in the two pastures in which the mineral was supplied alone had a higher ($P<.05$) sodium content than that of cattle receiving mineral and cultured yeast. The difference in sodium content of the herbage and hair is not attributed to the treatments imposed, but more likely was a result of differences in soil fertility at different locations.

Potassium, iron, copper, and zinc concentrations were found to be relatively consistent in the herbage, serum and hair with both methods of feeding mineral.

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