PROVIDING SUPPLEMENTAL NUTRIENTS IN DRINKING WATER TO GROWING CATTLE

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Story in Brief

The potential of different routes of supplementation (drinking water vs feed) and the timing of supplementation in the feed (morning vs evening) to deliver dietary ingredients of high nutritive value postruminally was investigated using growing steers. Over two-thirds of the water was consumed within 4 hours after feeding; hence, nutrients may be flushed through the rumen naturally. Casein offered in water, as compared to in feed, tended to increase N retention as proportion of intake and to decrease plasma urea levels. Nitrogen utilization was greater for casein than urea, but morning vs evening feeding of casein proved comparable. B-vitamin supplementation in the drinking water vs the feed, increased N output in urine (31.4 vs 23.4 g/day) but decreased total protein in plasma. Dietary supplementation with B-vitamins increased free fatty acids in plasma and decreased insulin concentration, suggesting that altering B-vitamin supply can alter lipid metabolism. Results indicate that drinking water may be useful as a means to strategically supplement cattle postruminally with specific nutrients.

(Key Words: Cattle, Water Kinetics, Supplementation, Ruminal Evasion.)

Introduction

From 40 to 80% of water consumed by adult cattle evades the rumen (Garza and Owens, 1989). Increasing ruminal evasion of ingredients of high nutritive value improves their overall utilization. Casein is fermented rapidly in the rumen and some B-vitamins are degraded in the rumen as well. Hence, water may provide one means to supplement nutrients postruminally, enhancing cattle performance and efficiency.

Based on the above concept, this trial was conducted to measure nutrient utilization in growing steers given casein or a B-vitamin supplement

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in the feed or the drinking water. Morning vs evening feeding of casein in feed also was investigated.

Materials and Methods

Five yearling steer calves (690 lb) in metabolism crates were fed 1.8% BW/day at 8 a.m. and 8 p.m. a diet composed of 2.2 lb of prairie hay and 9.2 to 12.8 lb of a 9.5% crude protein concentrate (Table 1). All calves had free access to water, with consumption being recorded at various intervals during the day. Two sets of treatment supplements (casein and a swine based B-vitamin mixture) were superimposed on a 4 x 5 Youden Square (Table 2). The B-vitamin mixture composition is shown in Table 3. Each of the four 10-day periods consisted of five days for adaptation to treatment followed by five days for collection of feces and urine. Daily casein treatments were: A) basal diet plus urea (80 g/head); B) basal diet plus casein in 0800 feeding (246 g/head); C) basal diet plus casein in 2000 feeding (246 g/head); D) basal diet plus casein dissolved in drinking water (from 27 to 45 g/gallon). Daily B-vitamin treatments were: a) no B-vitamin supplementation; b) B-vitamins in feed (2 g/head); c) B-vitamins in drinking water (from 1.6 to 1.8 g/head). Digestibility was estimated using chromic oxide as a marker. Jugular blood samples were collected one hour before and two hours after morning and evening feedings via a catheter on the last day of each experimental period.

Table 1. Ingredient and nutrient composition of concentrate (dry matter basis).

Ingredient	Percent
Corn dent, cracked	70.8
Cottonseed hulls	14.5
Alfalfa hay	5.9
Molasses, dried	5.4
Salt	.6
Limestone	.6
Dicalcium phosphate	.6
Urea, 42.5% N	.1
Aureomycin 50	.15
Crude protein	9.5
Organic matter	96.7

Table 2. Experimental design.

	Animal				
Period	1	2	3	4	5
I	Ac	Da	Ba	Cc	Bb
II	Ca	Bc	Ab	Db	Da
III	Db	Cb	Db	Aa	Cc
IV	Bb	Ac	Cc	Ba	Ab

A = Basal diet + urea.
B = Basal diet + casein morning feeding.
C = Basal diet + casein evening feeding.
D = Basal diet + casein in water.
a = No B-vitamin supplementation.
b = B-vitamin in feed.
c = B-vitamin in water.

Table 3. B-vitamin supplement composition[a].

Ingredient	Amount, g/lb
Niacin	49.277
d-pantothenic acid	49.277
Riboflavin	14.045
Thiamin	7.090
Pyridoxine	7.090
Folic acid	2.100
Biotin	.360
Vitamin B12	.035
Ascorbic acid	135.954
Dextrose	112.377

[a] As provided by manufacturer. Values do not total 454 g because individual sources of vitamins are not fully active.

Results and Discussion

Organic matter, crude protein and water intakes were similar among casein treatments (Table 4). Twice as much water was consumed within 4 h after feeding as compared to between meals (1.8 vs .9 gal). N digestibility tended to be lower ($P<.10$) when casein was offered in the drinking water, but decreased urinary N output caused efficiency of retention of dietary N to

Table 4. Least squares means for casein treatments.

Item	Treatments[a]				
	Urea	Casein AM	Casein PM	Casein in water	SE
Intake/day:					
OM, lb	10.6	10.8	10.8	10.6	.4
N, g	103.9[c]	101.2[bc]	100.7[bc]	92.8[b]	3.6
Water, gal	4.2	5	4.6	5.2	.5
Digestibility, %					
OM	64.9	66.3	66.2	64.3	1.6
N	56.4[bc]	55.6[bc]	59.2[c]	53.4[b]	1.8
N-balance, g/day:					
Feces	45.5[c]	45.1[c]	40.7[b]	43.0[bc]	1.8
Urine	31.8[c]	27.0[bc]	28.6[c]	20.7[b]	2.7
Retained	26.6	29.1	31.4	29.2	2.6
Retained, % of intake	25.7[b]	28.8[bc]	30.8[bc]	31.3[c]	2.2
Plasma parameters:					
Total protein, g/dl	4.77[c]	4.84[c]	4.52[b]	4.83[c]	.11
Urea, mg/dl	14.8[d]	12.4[c]	12.7[c]	9.2[b]	.87
Albumin, g/dl	1.45[b]	1.45[b]	1.71[c]	1.57[bc]	.10
Glucose, mg/dl	70.2[b]	69.8[b]	72.2[c]	71.5[bc]	.70
Free fatty acids nMol/ml	144.2[c]	95.2[b]	114.8[b]	114.8[b]	8.6
Insulin, uIU/ml	13.7	14.6	14.7	13.4	.73

[a] Urea, casein AM (morning) and PM (evening) were offered with the feed.

[b,c,d] Means in the same row with different superscripts differ ($P<.10$).

be unchanged (Table 4). The higher protein concentration in plasma together with lower values for plasma urea may reflect better utilization of absorbed N in animals consuming casein in their water as compared to those given casein in their feed. Morning vs evening feeding had no effect on dietary N utilization. Previous studies (Garza et al., 1990) indicated that water intake and potential flushing through the rumen might be greater in the evening.

Addition of B-vitamins to the drinking water vs the feed increased N output in urine (P<.10) and decreased plasma total protein even though albumin concentration was increased (Table 5). Supplementation with this

Table 5. Least squares means for B-vitamin treatments.

Item	Treatments			
	No B-vitamins	B-vitamins in feed	B-vitamins in water	SE
Intake/day:				
OM, lb	10.5	10.7	11.0	.4
N, g	98.4	97.8	103.4	3.5
Water, gal	4.8	4.8	4.6	.5
Digestibility, %				
OM	66.4	64.1	66.2	1.3
N	55.9	54.6	58.5	1.7
N-balance, g/day:				
Feces	43.3	44.3	42.9	1.8
Urine	27.4[ab]	23.4[a]	31.4[b]	2.6
Retained	27.7	30.0	29.1	2.4
Retained, % of intake	28.0	30.8	28.1	2.1
Plasma parameters:				
Total protein, g/dl	4.81[ab]	4.84[b]	4.58[a]	.09
Urea, mg/dl	11.8	12.1	13.0	.91
Albumin, g/dl	1.40[a]	1.50[a]	1.74[b]	.09
Glucose, mg/dl	70.6	71.5	70.5	.65
Free fatty acids nMol/ml	98.9[a]	127.5[b]	122.1[b]	7.9
Insulin, uIU/ml	15.1[b]	13.8[ab]	13.5[a]	.69

[a,b] Means in the same row with different superscripts differ (P<.10).

B-vitamin mixture, either with the feed or in the water, increased (P<.10) free fatty acids concentration in plasma and insulin tended to decrease.

These results suggest that providing supplemental nutrients in water may shift the site of nutrient absorption and thereby could prove useful as an alternative to feeding to increase supply of nutrients postruminally.

Literature Cited

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