Fermented, Ammoniated Whey - Its Energy and Protein Value

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Story in Brief

A rolled corn diet was supplemented with either urea, urea plus lactate (UL), soybean meal (SBM) or fermented ammoniated condensed whey (FACW), and fed to steers in a metabolism respiration calorimetry trial. Nitrogen digestibility (percent), N retention (g) and ruminal ammonia values for U, UL, SBM and FACW rations were 69.5, 73.9, 76.5, 71.4; 10.7, 8.3, 27.3, 12.9; and 30.6, 23.9, 13.9 and 27.5, respectively. Metabolizable energy values of the rations were 2.98, 3.02, 3.27 and 2.99. FACW (wet basis) was calculated to have a metabolizable energy value 51 percent the value of corn grain. Methane production and the acetate to propionate ration were not altered by additives.

Introduction

Nearly 15 million tons of whey are produced annually in the United States as a by product of the dairy industry. Although several processing techniques for whey have been suggested, the potential for its recycling in ruminant feeds has received relatively little attention. One recycling technique ferments the whey plus ammonia with a strain of bacteria to produce lactic acid and bacterial protein. This is condensed by evaporation to 55 percent dry matter. Commercially produced by Calor Agriculture Ltd, Okemos, MI, this product is called fermented ammoniated condensed whey (FACW). As a percent of the dry matter, FACW contains 44 percent crude protein, mostly as ammonium lactate and 80 percent lactate. It has been proposed that rations high in lactic acid tend to decrease ruminal production of methane which could reduce energy

Table 1. Ration composition, dry matter basis.

Item	Ration			
	U	UL	SBM	FACW
		%		
Corn, rolled	76.5	69.1	64.6	69.0
Cottonseed hulls	10.8	10.7	8.5	10.6
Soybean meal	0	0	17.0	0
Urea	2.7	2.9	0	0
Lactic acid	0	3.94	0	0
FACW	0	0	0	7.96
Alfalfa hay, ground	5.4	5.4	5.3	5.3
Limestone	3.96	3.93	3.74	3.89
Salt, trace mineralized	1.32	1.31	1.13	1.29
Vitamins A & D	.12	.12	.12	.12
Analysis				
Dry matter	85.22	83.24	85.94	84.40
N, % of DM	2.51	2.68	2.55	2.52

Table 2. Metabolism trial results.

Item	Ration			
	U	UL	SBM	FACW
Animal, no.	4	4	4	4
Dry matter				
Feed, kg DM	3.34[ab]	3.14[a]	3.87[b]	3.48[ab]
Feces, kg	.846	.777	.834	.939
Digestibility, %	74.0	75.0	78.6	72.6
Nitrogen				
Feed, g	83.6	83.9	98.7	87.8
Feces, g	24.7	21.5	23.3	24.5
Urine, g	48.2	54.1	48.1	50.4
Digestibility, %	69.6	73.9	76.5	71.4
N retention, g	10.7[a]	8.3[a]	27.3[b]	12.9[ab]
Ruminal NH_3-N, mg/dl	30.6[b]	23.9[ab]	13.9[a]	27.5[b]

[ab]Means within a trial with different superscripts differ statistically ($P<.05$).

Table 3. Calorimetry results.

	Ration			
	U	UL	SBM	FACW
Energy, % of consumed				
Feces	26.8	25.8	21.6	27.5
Urine	3.2	3.3	2.7	2.7
Methane	7.2	6.3	7.2	7.1
Heat	59.8	66.4	58.1	61.0

Table 4. Gas and VFA's.

Item	Ration			
	U	UL	SBM	FACW
Respiratory quotient	0.99[b]	0.89[a]	0.94[ab]	0.98[b]
VFA, molar ratio				
Acetate	56.7	60.9	53.8	51.2
Propionate	20.6	19.1	28.2	23.8
Butyrate	17.0	14.1	12.8	18.7
Isobutyrate	1.4	1.2	1.4	1.2
Isovalerate	1.0	1.0	0.7	0.8
Valerate	1.7	1.7	1.8	2.1
Total concentration, mM	102.0	112.3	99.2	105.9
C_2/C_3	3.18	3.73	2.52	2.44
Non-glucogenic	4.80	5.28	3.55	4.10

[ab]Means within a trial with different superscripts differ statistically ($P<.05$).

Table 5. Ration energy concentrations (kcal/g dry matter).

Item	Ration			
	U	UL	SBM	FACW
Gross	4.25	4.26	4.32	4.28
Digestible	3.16	3.16	3.39	3.10
Metabolizable (ME)	2.98	3.02	3.27	2.99

loss during ruminal fermentation. The purpose of this study was to evaluate energy and nitrogen availability of FACW and to also observe the effect of added lactate on ruminal methane production and ruminal acid levels.

Materials and Methods

Four 344 kg yearling steers were fed a rolled corn based ration (Table 1) with supplemental FACW, urea, UL or SBM. Urine and feces were collected the last five days of each 14 day period and steers were rotated among rations. Face masks were used for collection of respiratory gases for 12 hr beginning 1 hr after initiation of feeding the last day of each period. Oxygen consumption, and CO_2 and CH_4 production were monitored. On the final day of each period, rumen samples were obtained for analysis.

Results and Discussion

Dry matter and nitrogen digestibility tended to be the greatest for the steers fed the SBM supplemental ration followed by UL, U, and FACW supplementation (Table 2). Nitrogen retention was somewhat higher for SBM and FACW fed steers while ruminal ammonia values were lower for steers fed SBM than those fed U and FACW. This suggests that the ammonia from FACW is available in the rumen. As a percent of consumed energy, methane production for U, UL, SBM and FACW rations was 7.2, 6.3, 7.2, 7.1 (Table 3). No significant differences were detected in the digestible or metabolizable energy content of the rations. The respiratory quotient (CO_2/O_2) was lower for UL than U, SBM or FACW fed steers (Table 4). The acetate molar ration for FACW fed steers tended to be slightly lower than for the other rations. Based on ME (Table 5), FACW has an energy content of 1.41 kcal/g of material as fed. Using the mean of 1.41 kcal/g FACW and 2.76 kcal/g for corn grain at 15.5 percent moisture, the best estimate from this trial would be that FACW has 51 percent of the ME of corn grain. Calculated digestible and net energy values for FACW are also less than corn grain. No reduction in methane production was apparent. This refutes the idea that added lactate depresses methane production in the rumen so that high lactate feeds and silages would have slightly extra nutritional value.