

The effects of shredded sugar beets on sheep nutrient metabolism and ruminal characteristics

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INTRODUCTION

- During the 2014-2015 sugar beet harvest in Montana, 45.2 million pounds of sugar beets were not harvested.
- Excellent energy source (81% TDN; Lardy and Schafer, 2008)
 - Could potentially replace more traditional feedstuffs such as barley or corn.
- Sugar beets differ;
 - Higher moisture content (70-80% moisture; Lardy and Schafer, 2008).
 - Energy storage in the form of sucrose rather than starch (12-20% sugar; Agribusiness Handbook, 2009).
 - Less crude protein (barley 12% CP, corn 9% CP; Beef Magazine; sugar beets 6.8% CP; Lardy and Schafer, 2008).

HYPOTHESIS

We hypothesized that increasing levels of sugar beets in the diet would have no deleterious effects on fiber or nitrogen digestibility.

OBJECTIVES

To evaluate the effects of increasing levels of sugar beets in the diet on sheep nutrient metabolism and ruminal characteristics.

MATERIALS AND METHODS

- A 4 X 4 replicated Latin Square design was used to evaluate the effects of the four dietary treatments on nutrient metabolism and ruminal characteristics of eight wethers.

Timeline

- Each experimental period was 20 d in length.
 - Day 1 to d 5: Wethers were in a single pen with access to ad libitum hay and water.
 - On d 5, wethers were assigned dietary treatments and placed in metabolism crates for a 10 d adaptation period to the metabolism crates and diets.
 - Day 15 through d 19;
 - TMR was collected
 - Blood samples were collected via jugular venipuncture (4 h post-prandial).
 - Rumen fluid was collected on d 19
 - Day 16 through d 20;
 - Total fecal output was collected, weighed, and a subsample (7.5% of total weight) was frozen until analysis.
 - Total urine output was collected, weighed, and a subsample (25% of total weight) was taken out. 6 N HCl was added to urinals daily to induce a pH \leq 3 in the urine.
 - Orts were collected.



MATERIALS AND METHODS continued...

Laboratory Analysis

- TMR and ort samples were dried in a 60°C forced air drying oven for 48-h for DM analysis.
 - Also analyzed for NDF and ADF using an Ankom 2000 Fiber Analyzer.
 - Nitrogen concentrations were also measured (method 2001.11; AOAC, 2010)
- Serum urea nitrogen (SUN) concentrations were determined by using a commercial colorimetric kit.
- Rumen ammonia concentrations were determined using a colorimetric assay, and rumen VFA concentrations were determined by using a gas chromatography procedure.

Statistical Analysis

- The MIXED procedure of SAS was used to analyze this data.
- Individual lamb was the experimental unit
- Significance was set, at $P \leq 0.05$ with tendencies set at $P \leq 0.10$.

RESULTS

- Quadratic effect for NDF intake.
- Quadratic tendency for ADF intake.
- Cubic effect for nitrogen intake.
- Quadratic tendency for ADF digestibility
- Linear tendency for ruminal ammonia and acetate concentrations to increase ($P \leq 0.09$) with increasing sugar beets in the diet.
- Ruminal propionate concentrations increased linearly, as well as the acetate to propionate ratio with increasing sugar beets in the diet ($P \leq 0.05$).
- Butyrate concentrations linearly increased with increasing sugar beets in the diet 4 hours after feeding ($P = 0.01$).
- pH demonstrated a quadratic tendency ($P = 0.08$) 4 hours feeding with increased sugar beets in the diet, with the highest value for 15SB (6.99) and the lowest value for 45SB (6.51).

IMPLICATIONS

- Sugar beets can replace barley in the diet up to 45% without any deleterious effects on nutrient metabolism.
- The increasing acetate to propionate ratio indicates that sugar beets may be best suited for lactating animals.



Table 1. Ingredient and nutritional composition of diets fed to growing wethers (DM basis).

Item	Dietary Treatment ¹			
	0SB	15SB	30SB	45SB
Ingredient, %				
Sugar beets ²	—	15.00	30.00	45.00
MSU barley	45.00	30.00	15.00	—
Grass hay	46.00	41.00	36.90	32.80
Soybean meal	5.50	10.40	14.80	19.00
NaCl	0.25	0.25	0.25	0.25
Decoquinatone	1.35	1.35	1.35	1.35
Calcium carbonate	1.00	1.10	0.85	0.75
Mineral premix	0.90	0.90	0.90	0.90
Nutritional Composition ⁴				
DM, %	28.33	24.97	22.59	20.72
TDN, %	66.80	65.80	64.80	63.60
CP, %	15.80	15.70	15.40	15.10
Ca:P	2.30	2.50	2.40	2.47

¹Diets (DM basis) were formulated for growing wethers according to NRC (2016). Treatments: **0SB**) 0% sugar beets, **15SB**) 15% sugar beets, **30SB**) 30% sugar beets, & **45SB**) 45% sugar beets.

²Sugar beets were coarse ground with a flail chopper designed for woody biomass, to reduce choking hazard.

Table 2. Nutrient metabolism characteristics of growing wethers fed increasing concentrations of sugar beets in the diet.

Item	Dietary Treatment ¹					Orthogonal Contrasts ³		
	0SB	15SB	30SB	45SB	SEM ²	Linear	Quadratic	Cubic
Initial BW, kg	36.65	36.65	36.65	36.65	0.00	1.00	1.00	1.00
Daily DMI, g/kg BW	29.12	26.01	28.03	30.43	2.51	0.61	0.30	0.68
Daily NDF intake, g/kg BW	12.48	9.57	10.50	11.14	0.85	0.41	0.04	0.27
Daily ADF intake, g/kg BW	7.80	5.96	6.88	7.13	0.60	0.68	0.09	0.20
Daily nitrogen intake, g/kg BW	0.68	0.63	0.90	0.74	0.07	0.10	0.33	0.02
Total tract digestibility, %								
DM	70.34	67.23	71.29	71.4	0.20	0.44	0.44	0.25
NDF	57.07	50.70	52.71	53.41	35.02	0.57	0.33	0.54
ADF	51.64	40.41	48.64	50.58	39.11	0.77	0.10	0.14
Nitrogen								
Daily nitrogen excretion, g/kg BW	74.83	72.66	74.95	72.22	1.88	0.37	0.85	0.19
Fecal								
Fecal	0.18	0.17	0.17	0.21	0.02	0.33	0.29	0.93
Serum urea nitrogen, mg/dL								
Serum urea nitrogen, mg/dL	5.65	5.03	4.39	4.87	0.53	0.22	0.31	0.63

¹Maternal diets (DM basis) were formulated for growing wethers according to NRC (2016). Treatments: **0SB**) 0% sugar beets, **15SB**) 15% sugar beets, **30SB**) 30% sugar beets, & **45SB**) 45% sugar beets.

²Greatest SEM presented (n = 8).

³P-value for linear, quadratic, and cubic effects of increasing sugar beet concentration in the diet.