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BEET PULP SUPPLEMENTATION OF HEIFERS GRAZING NATIVE FLOOD MEADOW: PERFORMANCE AND RUMINAL FERMINATION

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ABSTRACT: Sixty-four beef heifers (287 ± 2 kg) and 4 ruminally cannulated steers (286 ± 4 kg) were used in an 84-d study to evaluate beet pulp (BP) supplementation of early-to-mid season native flood meadow pasture. Treatments (TRT) consisted of an unsupplemented control (CON) and 0.25 (L), 0.50 (M), and 0.75 (H) kg/d dried BP. Heifers were gathered daily at 0730 from a common 35 ha pasture and sorted into pens (4 heifers/pen; 4 pens/TRT) and provided BP. After the BP was consumed (approximately 3 hr) heifers were returned to the common native flood meadow pasture. Heifers were weighed every 28 d and available forage determined by clipping 25 randomly placed 0.19-m^2 quadrats. In addition, rumen fluid was obtained via stomach tube on d 42 from one heifer randomly selected from each pen 4 hr after supplementation. Cannulated steers were used to estimate diet quality on d 0, 28, 56, and 84 by rumen evacuation/masticate collection procedures. Diet quality estimates were 23, 18, 15, and 12% CP and 44, 49, 53, and 58% NDF for d 0, 28, 56, and 84, respectively. Heifer ADG was not affected ($P > 0.10$) by BP supplementation (1.11, 1.08, 1.04, and 1.08 kg/d for CON, L, M, and H, respectively). In addition, ruminal NH_3 N and pH were not altered ($P > 0.05$) by BP supplementation. These data suggest that BP is not a beneficial supplement to growing beef heifers consuming high-quality native flood meadow.

Key Words: Beet Pulp, Supplementation, Grazing, Performance

Introduction

It has been suggested that low levels of energy supplementation can enhance gains of animals grazing forage in an early vegetative state (Horn and McCollum, 1987; Vanzant et al., 1990). As a result, grain supplementation is a common practice. However, starch-based supplements, such as corn, sorghum grain, wheat, and barley, can decrease cellulose digestibility and forage intake (Lusby and Wagner, 1986). The rapid fermentation of starch within the reticulo-rumen frequently results in decreased ruminal pH which impairs cellulolytic bacterial function and decreases fiber digestion.

Angell et al. (1995) supplemented beef heifers grazing native flood meadows in southeastern Oregon with 0.00, .50, .75, or 1.00 kg/d of cracked corn and observed no increase in performance. Also, in a study with beef cows consuming low-quality native grass hay, supplemental corn grain (up to 3 kg/d) decreased forage intake and digestibility of hemicellulose and cellulose (Chase and Hibberd, 1987).

Sources of readily fermentable fiber, such as beet pulp, soybean hulls, and wheat midds, offer an alternative to high-starch supplements. It has been proposed that high fiber energy supplements do not elicit the negative ruminal effects associated with starch supplements (Anderson et al., 1988; Martin and Hibberd, 1990). Reasons include lessening the inhibitory effects of starch digesting bacteria and(or) avoiding potential shifts in the ruminal microflora (Highfill et al., 1987). In addition, research has indicated that TDN from soybean hulls has 15 to 30% greater value for improving performance of growing cattle compared with TDN from corn (Garcés-Yépez et al., 1997). The research proposed in the following experimental plan was designed to determine the influence of increasing amounts of beet pulp on ruminant performance and diet digestibility.

Materials and Methods

Sixty-four Angus × Hereford heifers (287 ± 2 kg BW) were be blocked by weight and randomly assigned to one of the following treatments (**TRT**; 16 heifers/TRT) in an 84-d growth study beginning May 5, 2000: 1) unsupplemented control (**CON**); 2) 0.25 kg/d dried beet pulp; 0.50/d kg dried beet pulp; 0.75 kg/d dried beet pulp. Beet pulp nutrient content was 11.7% CP, 42.6% NDF, 23.1% ADF, and 91.8% OM (DM basis). Heifers were gathered daily at 0730, sorted into pens according to TRT (4 heifers/pen), and bunk fed supplement. Control heifers were immediately returned to pasture to continue grazing. In addition, four rumen cannulated Angus × Hereford steers (286 ± 4 kg BW) were allowed to graze (without supplementation) within the same pasture as the heifers. The experiment was conducted on a native flood meadow (35 ha) at the Eastern Oregon Agriculture Research Center 6 km south of Burns, OR, elevation 1230 m. Dominant grasses, sedges, and rushes have been described in past publications (Blount et al., 1991; Angell et al., 1995). Animals grazed one common pasture for the duration of the experiment.

Heifer BW was measured on d 0, 28, 56, and 84 following an overnight shrink (16-h). Ruminal fluid (approximately 40 mL) was collected with a 60-mL catheter-tip syringe (product # 309664; Becton-Dickinson, Rutherford, NJ.) and a stomach tube (Rumen Fluid Suction Strainer, Precision Machine Co., Inc, Lincoln, NE; 90 cm of

6.4 mm I.D. × 9.6 mm O.D. Tygon® tubing, Norton Performance Plastics, Akron, OH) at 1000 on d 42 from 1 heifer randomly selected from each replication (4 heifers/TRT). The first aliquot of ruminal fluid was discarded to minimize contamination by saliva. Ruminal fluid pH was measured immediately after collection (Orion SA 520, Boston, MA) and 5 mL acidified with 1 mL of 25% (wt/vol) meta-phosphoric acid. Acidified rumen fluid was placed on ice for transport to the lab and stored (-20°C) for subsequent analysis of NH_3 N. Frozen (-20°C) ruminal fluid samples were prepared for analysis by thawing, centrifugation (15,000 × g for 10 min), and collection of supernatant. Ammonia N was determined using a slight modification (sodium salicylate substituted for phenol) of the procedure described by Broderick and Kang (1980) using a UV/VIS spectrophotometer (Spectronic 710 spectrophotometer, Bausch & Lomb, Inc., Rochester, NY).

Rumen cannulated steers were caught on two consecutive d prior to each weigh d (d 0,28, 56, and 84) and their rumen evacuated (not withheld from grazing) as described by Lesperance et al. (1960), except that the ruminal wall was washed with a wet sponge and the steers allowed to graze for approximately 1 h. Rumen evacuations were at 1600 on day 1 and 0800 on day 2. The newly grazed masticate was removed and the initial ruminal contents replaced. Masticate samples were immediately frozen (-20°C) and lyophilized for determining chemical composition. Lyophilized samples were composited by steer within period, and ground with a Wiley mill (1-mm screen) prior to analysis. In addition, samples of beet pulp were collected weekly, dried at 55°C for 48 h, and ground through a Wiley mill (1-mm screen). Ground masticate samples and beet pulp were analyzed for OM, N, NDF, and ADF.

Quantity of live standing crop within the common pasture was estimated by clipping twenty-five randomly placed .19-m^2 quadrats to ground level on d 0, 28, 56, and 84.

Heifer performance data were analyzed as a randomized complete block design using the GLM procedure of SAS (1996). The statistical model included treatment and weight block. Response variables include: 1) ADG, 2) ruminal NH_3 N, and 3) ruminal pH. Non-orthogonal contrasts used to separate treatment means were: 1) CON vs supplemented; 2) linear effect of beet pulp; 3) quadratic effect of beet pulp. Standing forage and diet quality were analyzed as a completely randomized design using the GLM procedure of SAS (1996). The statistical model for standing forage included sampling date and replication while the model for diet quality included sampling date and steer. Response variables for diet quality included concentration of CP, NDF, ADF, and OM in masticate samples. Linear and quadratic effects of sampling date were used to separate treatment means.

Results and Discussion

Heifer final weight and study ADG were not affected ($P > 0.10$) by beet pulp supplementation (Table 1). In addition, ruminal NH_3 N (mM) and pH were similar ($P > 0.05$) for all treatments. This agrees with previous work by Angell et al. (1995) in which heifers grazing early-season native flood meadow and supplemented with increasing levels of cracked corn did not improve ADG compared with unsupplemented controls.

Standing forage increased quadratically ($P < 0.05$) as grazing season progressed while diet quality (CP, NDF, ADF, OM) decreased linearly ($P < 0.01$; Table 2). However, diet quality throughout the experiment was greater than or similar to beet pulp (11.7% CP, 42.6% NDF, 23.1% ADF, and 91.8% OM) and was sufficient to support excellent gains as demonstrated by the CON heifers. It is highly probable that nutrient intake by heifers was not increased due to beet pulp supplementation; therefore, supplementation provided little to no benefit while increasing feed costs.

Implications

Beet pulp supplementation of growing beef heifers grazing early-season native flood meadow does not influence animal performance. Therefore, it appears that beet pulp supplementation is not an economical option to include in grazing management plans for growing ruminants consuming high-quality native flood meadow pasture.

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Table 1. Heifer performance, ruminal ammonia, and ruminal pH in response to increasing levels of beet pulp

	Treatment[a]					P-Value[c]		
Item	CON	LBP	MBP	HBP	SEM[b]	Con vs Supp.	L BP	Q BP
Initial weight, kg	288	287	288	289				
Final weight, kg	381	378	375	380	3	0.37	0.59	0.32
Study ADG, kg/d	1.11	1.08	1.04	1.08	.03	0.35	0.84	0.38
Ruminal NH_3 N, (mM)	4.88	5.66	5.18	3.62	0.73	0.95	0.08	0.56
Ruminal pH	6.98	6.90	6.96	6.88	0.07	0.37	0.80	0.40

[a] CON = unsupplemented control; LBP = 0.25 kg hd^{-1} d^{-1}; MBP = 0.50 kg hd^{-1} d^{-1}; HBP = 0.75 kg hd^{-1} d^{-1}.
[b] n = 4.
[c] CON vs Supp. = control vs supplemented; L BP = linear effect of beet pulp; Q BP = quadratic effect of beet pulp.

Table 2. Standing forage and diet quality of native flood meadow

	Day[a]					P-Value[c]	
Item	0	28	56	84	SEM[b]	L	Q
Standing forage, kg/ha	1014	1421	2361	2087	152	<0.001	0.03
Masticate quality, %							
CP	22.7	17.8	14.7	12.1	0.5	<0.001	0.06
NDF	44.3	48.7	53.1	58.5	1.0	<0.001	0.61
ADF	23.2	25.0	28.7	30.5	0.5	<0.001	0.90
OM	86.9	87.2	84.6	83.8	0.6	0.002	0.39

[a] 0 = initial d of the study; 28 = d 28 of the study; 56 = d 56 of the study; 84 = d 84 of the study.
[b] n = 25 for standing forage and 4 for nutrient concentrations.
[c] L = linear effect of sampling d; Q = quadratic effect of sampling d.