Days on Feed and Dietary Sulfur Content Affect Rumen Hydrogen Sulfide Concentrations in Feedlot Steers

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Mary Drewnoski, postdoctoral research associate;
Erin Richter, graduate assistant;
Stephanie Hansen, assistant professor in animal science

Summary and Implications

Factors other than sulfur intake alone appear to contribute to the risk of sulfur induced polioencephalomalacia (PEM). For feedlot cattle fed high sulfur (S) diets, the first 30 d of the finishing period may be a time of increased risk. In the current study, concentrations of hydrogen sulfide (H_2S) did not differ due to level of dietary S until roughage content in the diet was below 30% and the greatest concentrations of H_2S were recorded after steers consumed a finishing diet (8% hay) for 25 d. When feeding high levels of dietary S, producers should consider management strategies that increase ruminal pH of feedlot steers such as increasing the level of roughage in the diet.

Introduction

Ethanol production has changed the way that producers in the Midwest feed cattle. Utilization of corn for ethanol production has increased, and will continue to increase for the foreseeable future. During ethanol production the corn starch is fermented to ethanol while the protein, fiber and fat in the corn are concentrated into co-products (distiller's grains and condensed corn solubles). These co-products are a logical substitute for corn in beef feeding systems as they are economical and rich in protein and energy. However, during ethanol production sulfuric acid is used to control pH in the fermentor and for cleaning. As a result, ethanol co-products often have highly variable and sometimes quite high S concentrations. Although sulfur is required by rumen bacteria and by the animal itself for growth and reproduction, intake of high dietary S can be problematic. Excess S may lead to increased production of H_2S gas in the rumen which can result in PEM in cattle, commonly referred to as polio or brainers. Cattle appear to be more susceptible to PEM on a high concentrate diet, as a result the majority of cases of PEM are observed in feedlot cattle and a great deal of these PEM cases appear to occur early in the finishing period.

Materials and Methods

To investigate the effects of dietary sulfur level, transition diet, and days on feed on ruminal H_2S concentrations, 96 yearling steers were blocked by weight (724 ± 64 lbs initial bodyweight) and assigned to receive either a low S distiller's grains (DDGS; control; C) or control plus 0.3% S added in the form of sodium sulfate (high S; HS) supplement while grazing bromegrass pastures for 35 d. Steers were then moved into the feedlot (4 steers per pen) and received *ad libitum* hay plus 1% BW DDGS for 10 d, followed by three 7 d step-up diets (Table 1). When steers were moved into the feedlot, half of the steers remained on their original S treatment (trt) and half were switched to the opposite trt. One steer per pen was sampled for rumen H_2S gas concentrations using Kitagawa gas detector tubes approximately 6 h after feeding on the last d of each transition diet, and on d 25, 59 and 86 of the finishing period. Results were analyzed using PROC MIXED of SAS (SAS Inst. Inc., Cary, NC).

Results and Discussion

During the grazing period concentrations of H_2S did not differ ($P = 0.90$) due to trt (1610 vs. 1614 ppm for C and HS, respectively). Additionally, previous S diet did not affect DM intake or H_2S concentrations ($P > 0.10$) during the transition and feedlot period; therefore only dietary feedlot trt means are presented. Despite the increased level of S in the high S diet, DM intake did not differ among trt ($P = 0.50$). Thus S intake of HS was consistently double that of C throughout the trial (Figure 1).

Concentrations of ruminal H_2S did not differ ($P > 0.15$ due to dietary S trt until hay was less than 30% of the diet (Figure 2). Daily S intakes within trt did not differ when cattle were consuming step up diet 3 (d 26-32) and the finishing diet on d 54-60 ($P > 0.40$; Figure 1), yet H_2S levels for both trt were greater ($P < 0.01$) on d 56 vs. d 31(Figure 2), suggesting that factors other than S intake alone contributed to increased production of ruminal H_2S during this time period.

Two steers on the high S diet were diagnosed with PEM during the first 30 d of feeding the finial finishing diet and were removed from the study. Interestingly, S intake increased later in the finishing period and yet no signs of toxicity were observed. The apparent increased susceptibility to S toxicity during the first 30 d on a full finishing diet is consistent with reports of increased incidences of PEM and increased concentrations of ruminal H_2S in feedlot cattle consuming high S water early in the feeding period. Decreases in rumen pH or increased availability of electron donors such as H_2, lactate, or propionate for metabolism of sulfate reducing bacteria during the early part of the finishing period may explain the increase in ruminal H_2S concentrations.

Since low pH favors the formation of and increases the concentration of H_2S in the rumen gas cap, management strategies that maintain a higher rumen pH such as feeding

increased levels of roughage may lower risk when feeding high levels of dietary S to feedlot cattle. Additionally, waiting to increase dietary inclusion of high S co-products until after the rumen environment has adapted to a high concentrate diet may reduce the risk of toxicity; however, there is currently no data on this management strategy.

Table 1. Composition of total mixed rations[1] fed to steers during the transition and finishing period.

	Day in feedlot			
	11-17	18-24	25-31	32 - slaughter
Ingredient	% Total Diet (DM Basis)			
Chopped Hay	45	30	15	8
DDGS	40	40	40	40
Corn	13	26	41	48
Corn or S corn[2]	2	2	2	2
Minerals/ Bovatec91	2	2	2	2

[1]Control diet contained 0.2% -0.3% S and high S diet contained 0.5% - 0.6% S

[2] S corn was a mixture of corn and sodium sulfate formulated to increase S content of diet by 0.3%.

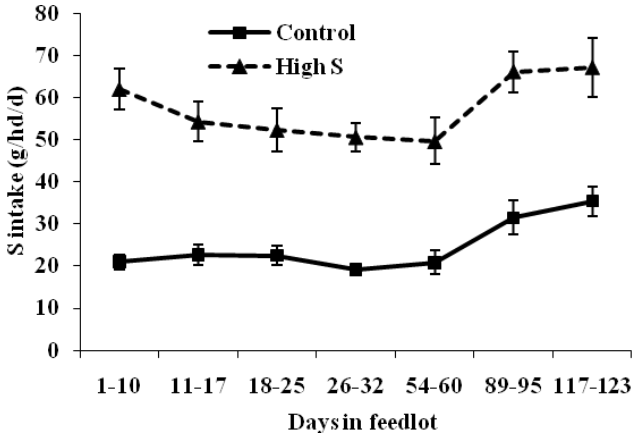

Figure 1. Dietary sulfur intake (g/hd/d) of feedlot steers during the transition and finishing period. Sulfur intake differed ($P < 0.01$) between control and high S at all timepoints.

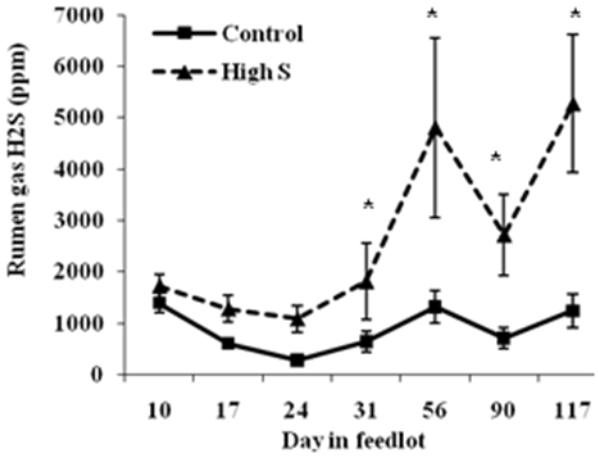

Figure 2. Ruminal hydrogen sulfide concentration (ppm) of feedlot steers during the transition and finishing period. Treatment differences ($P < 0.05$) within date are indicated with an astrik.

Acknowledgments

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