Effect of Sulfur Content of Distillers Grains on Protein Digestion in Ruminants using *In Situ* and *In Vitro* Procedures

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Abstract # 38

Introduction

Because of growing popularity in utilization of alternative fuel sources and increasing costs of animal feed, byproduct feeds are being utilized more in the livestock animal industry. Dried Distillers grains (DDGS) are a byproduct of ethanol distillation and provide a more affordable feed ingredient to fulfill protein requirements of ruminant animals than typical dietary protein sources. However, the distillation process integrates a greater concentration of sulfur (S) into the corn grain product. Over supplementation of sulfur has been shown to be detrimental to cattle's health as well as lower production of animal products, such as meat and milk.

The objective of this project is to examine various levels of dietary sulfur within distiller's products and to determine the correlation with protein hydrolysis in the rumen. Variables that will be analyzed are initial sulfur content of distillers grain sources, gas production and hydrogen sulfide concentration from microbial fermentation, and rumen undegradable protein (RUP).

Materials and Methods

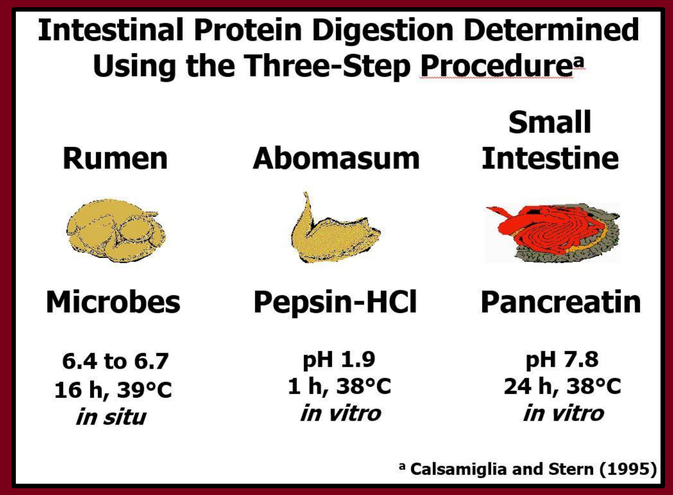
- Five DDGS samples were obtained with very low, low, medium, high, and very high sulfur content (table 1).

Table 1. Sulfur composition and initial pH of DDGS Samples.

S level of DDGS	Sulfur	initial pH
Very Low	0.46	5.2
Low	0.66	4.55
Medium	0.93	4.38
High	1.15	4.13
Very High	1.39	3.9

- *In vitro* batch culture was conducted on each of the five treatments with soybean meal (SBM) used as the standard.
- A colorimetric test for hydrogen sulfide gas produced during fermentation was conducted on a subsample of gas taken from headspace of batch culture bottles. Color absorbance was determined with a BioTek Eon plate reader at 665 nm.
- The five DDGS samples and the SBM standard were analyzed using a three step procedure to determine intestinal crude protein digestion (Figure 1).
- *In situ* protein degradation in the rumen was evaluated for the samples using two cannulated lactating dairy cows with time points at 0, 2, 8, 16, 24, and 48 hours.
- Nitrogen was measured for the three step procedure and *in situ* degradation curve using steam distillation Kjeldahl method.
- Statistics were analyzed using SAS 9.2 PROC CORR.

Figure 1. Schematic of the three-step procedure used to measure intestinal protein digestion.



Results

Figure 2. Effect of sulfur content on production of hydrogen sulfide using *in vitro* batch culture.

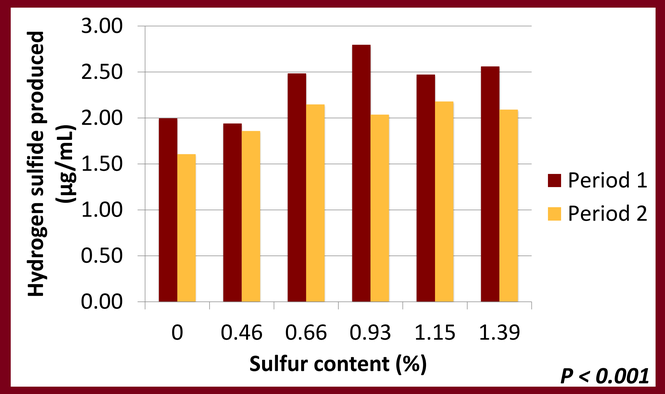


Table 2. Correlation of original sulfur content of each source of DDGS with total gas (*P = 0.38*) and hydrogen sulfide (*P < 0.001*) production values in 24 hour experimental periods.

		Period			
		1		2	
Product	Sulfur	Gas (mL)	H_2S (µg/mL)	Gas (mL)	H_2S (µg/mL)
Very Low	0.46	80.5	1.94	76.5	1.86
Low	0.66	69.8	2.49	76.5	2.15
Medium	0.93	71.8	2.80	79.1	2.04
High	1.15	75.5	2.47	69.1	2.18
Very High	1.39	72.5	2.56	77.8	2.09

Figure 3. Crude protein (CP) degradation expressed as % CP remaining during 48 hour ruminal incubation.

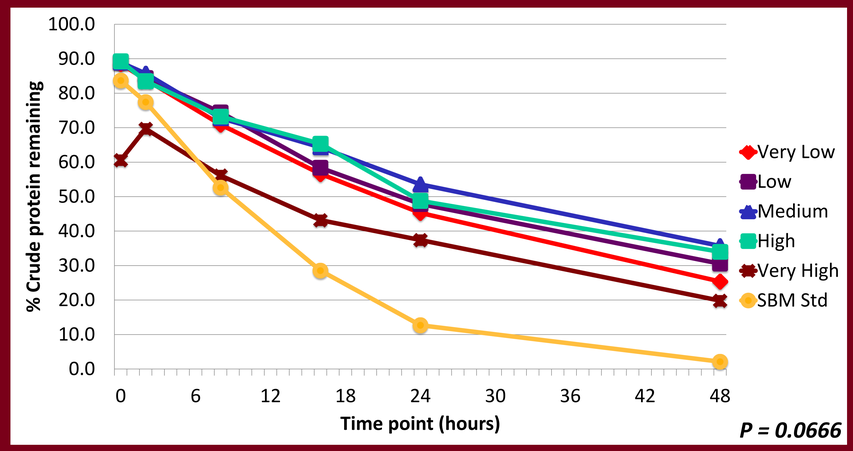
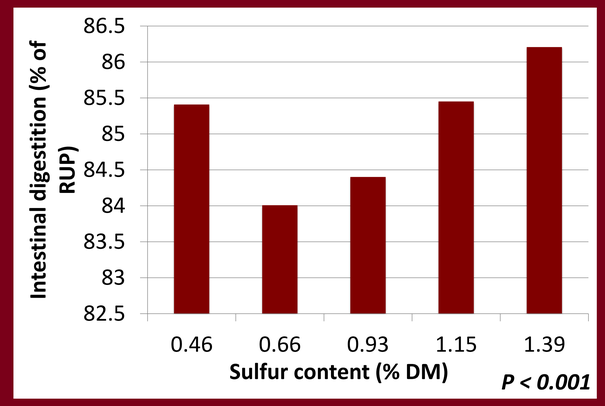


Figure 4. Effect of sulfur content on intestinal crude protein digestion.



Summary

- An increase in sulfur content of DDGS increased (*P < 0.001*) hydrogen sulfide production, but did not alter (*P > 0.05*) total gas production produced from DDGS fermentation.
- There was a trend (*P = 0.07*) that showed a correlation between rumen undegraded protein and sulfur content.
- Intestinal crude protein digestion was correlated (*P < 0.001*) with sulfur content (*P < 0.001*). As sulfur content increased, intestinal crude protein digestion increased.