Rumen Microbes Associated with Response to High-Sulfate Drinking Water in Lambs

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Introduction
Water is the most important nutrient because it is involved directly or indirectly in almost every physiological process essential to livestock health. Range livestock frequently only have access to water sources that are less than ideal due to a combination of drought, urbanization, and mineral extraction, coupled with Wyoming’s semiarid environment (Figure 1). Ruminant livestock are particularly susceptible to high dietary sulfur, which can cause health problems and reduced performance. Elevated levels of sulfur are often encountered in the form of high-sulfate drinking water in the western U.S. Microbes in the rumen use the sulfate to produce hydrogen-sulfide ($H_2S$) gas, and when the host ruminant consumes high-sulfate drinking water, overproduction of $H_2S$ occurs. The $H_2S$ can be eructated and re-inhaled by the animal. The inhaled $H_2S$ acts as a neurotoxin and can lead to reduced health and performance as well as irreversible brain damage. Unfortunately, there has been limited success in treating ruminants affected by high-sulfate water. This is partly due to an inadequate knowledge of the role that rumen microbes play in the host response to this water. Determination of rumen microbial species important in the response to high-sulfate water may lead to development of successful treatments and prevention strategies.

Objectives
The objective of this study is to determine changes in the rumen microbial population in response to administration of high-sulfate water in growing lambs.

Materials and Methods
Growing Hampshire and Hampshire-cross lambs (n=12) were individually penned for a 35-day trial period in 2015 at the Laramie Research and Extension Center (LREC) to enable collection of individual daily water and feed intake. They were administered high-sulfate drinking water for 28 days and then administered low-sulfate drinking water for the final seven days of the trial. Rumen fluid was collected and body weights were recorded on days 0, 7, 28, and 35. Rumen fluid samples from eight lambs over the four time points were used for DNA sequencing to determine microbial species and quantity (32 samples in total).

Results and Discussion
There were 287 microbial species present in at least one of the eight lambs over the four time points. Of those species, 32 changed in abundance over time. A number of species increased in abundance after administration of the high-sulfate water and then returned to baseline abundance, suggesting that these species may be capable of adapting to a high-sulfate environment. In addition, some species that increased in abundance are classified as cellulolytic bacteria, which are known to utilize sulfur.

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to produce amino acids. The next step in this study is to further elucidate the roles these microbes may play in the host response to high-sulfate water. Identification of microbial species instrumental in this response may pave the way for development of treatments for affected ruminants.

**Acknowledgments**
We thank LREC for assistance with the animal trial. This study is supported by grants from the Wyoming Water Research Program (administered by the University of Wyoming’s Office of Water Programs) and the U.S. Geological Survey.

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**Keywords:** microbes, sheep, sulfate

**PARP:** not applicable