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Summary

An in vitro *procedure was modified to estimate rumen buoyancy of corn bran and fiber types. Inoculum was obtained from two beef heifers and mixed with McDougall's buffer then distributed to the in vitro tubes for 30 hours incubation at 100ºF. Fibrous material formed a matte layer which was measured to describe buoyancy. Tubes contained 6g of a feedlot-type diet with 7.5% fiber type (alfalfa hay, grass hay, corn silage, or corn stalks), with no replacement or 25% replacement of the remaining corn with corn bran. Buoyancy declined over time. Alfalfa hay had the most positive effect on buoyancy of corn bran. This new method offers promise for describing rumen buoyancy.*

Introduction

Corn bran has potentially high digestible fiber (*2005 Nebraska Beef Report,* pp. 39-41), however, rumen retention time determines digestibility. Rumen retention time of corn bran has not been clearly determined within a feedlot steer on a high concentrate diet with little fibrous matte layer.

When fibrous feedstuffs enter the rumen, the microbes attach to the fiber and produce gas which is trapped with the fiber particles. The suspension (or buoyancy) of the fiber particles with trapped gas above the liquid portion within the rumen is considered the matte layer. Buoyancy decreases over time as the fiber particles are digested. Greater buoyancy in the rumen is hypothesized to allow greater fiber retention time and digestibility. In concentrate-fed animals, the presence of a matte layer and fiber buoyancy may be low considering the low fiber content of the diets. Describing buoyancy over time of various feedstuffs, particularly corn bran, can be a useful tool when evaluating fiber characteristics and extent of fiber digestibility. Therefore, the objectives of this project were (1) to develop a technique to describe the buoyancy characteristics of corn bran over time and (2) to evaluate the effect of fiber type on buoyancy.

Procedure

Several modified *in vitro* trials were conducted to establish a procedure for measuring buoyancy over time. Initially, simple substrate samples of grass hay at different levels in 300mL glass test tubes were used. The amount of 150mL inoculum (1:1 ratio of McDougall's buffer and rumen fluid) in the tube was necessary to precisely measure matte layers over time. Two donor heifers on a mixed diet consisting of 70% ground grass hay, 15% dry rolled corn, and 15% soybean meal (DM basis) were used to collect rumen fluid prior to morning feeding. Rumen fluid was strained through four layers of cheesecloth.

Before distribution of the 150mL inoculum, 1.5g of 2mm ground grass hay substrate was placed in each tube. The tubes were incubated in a 100ºF water bath for 30 h. Matte layer measurements were taken with a caliper ruler as a means for determining buoyancy over time. Just before these measurements were obtained, the tubes were swirled by hand and placed back into the water bath for approximately 10 minutes allowing the remaining buoyant fiber particles to float and be measured.

In the first experiment, rumen fluid was collected from two heifers consuming a diet of 50% dry rolled corn, 20% wet corn gluten feed, 20% wet distillers grains with solubles, 7% ground alfalfa hay, and 3% dry supplement containing an equivalent 300 mg/hd/day Rumensin® (DM basis). The substrate in each tube consisted of 6g feedlot-type diets containing mostly dry corn. This corn was used to represent a feedlot type diet and to bring the inoculum pH within a range that would be observed shortly after cattle consume a high concentrate meal. Tubes were incubated for 30 hours and matte layer measurements were taken at h 2, 8, 15, 22, and 30 and expressed as mL.

Two 30-hour *in vitro* runs with a 4 X 2 factorial arrangement of treatments were conducted. Tubes contained 6g DM of feedlot-type diets with calculated 7.5% (0.45g) fiber level with four fiber types of alfalfa hay, brome hay, corn silage (assumed 50% fiber), and corn stalks, each ground to 2mm. The remaining 92.5% (5.55g DM) consisted of ground dry corn or 25.0% of the corn replaced with corn bran. The objective of these runs was to evaluate effects of fiber types on the rumen buoyancy of corn bran.

Statistical effects were tested using the mixed procedures of SAS with tube as the experimental unit and time as a repeated measure.

Results

Buoyancy decreased for all treatments across time, which would be expected. As fiber digestion proceeds less substrate is available and therefore gas production decreases. The decreasing gas production allows fiber particles to have higher specific gravity and sink to the bottom of the tube (rumen). Matte layer measurements converged after 14 hours for all treatments, while treatments containing corn bran

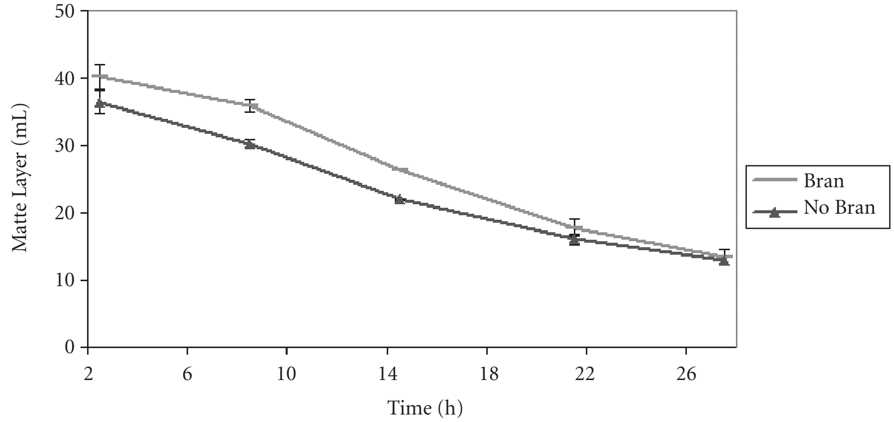

Figure 1. Response of corn bran on matte layer as estimated *in vitro*. Standard error bars indicate variation around the means.

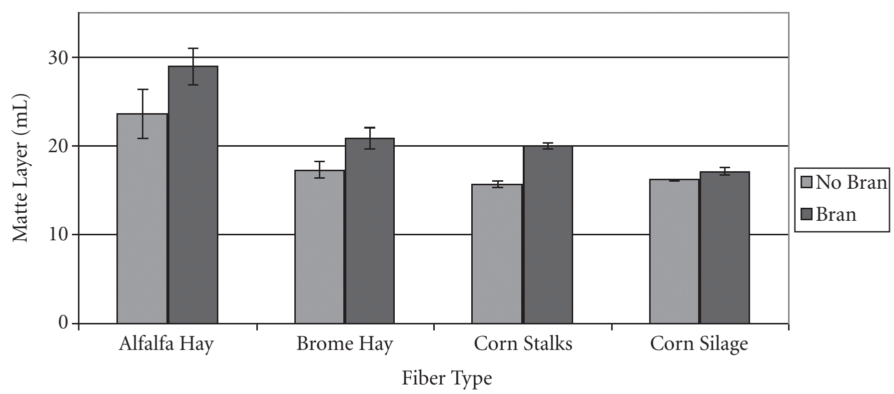

Figure 2. Response of fiber type and influence of corn bran buoyancy on matte layer at 14 hours as estimated *in vitro*. Standard error bars indicate variation around the means.

had increased (*P*<0.01) matte layer measurements through 14 hours compared to treatments containing corn only (Figure 1). Treatments with alfalfa hay had greater (*P*<0.01) matte layer measurements (26.3mL) than the other fiber types (17.9mL) when paired with both corn only and corn with corn bran, indicating longer retention time within the rumen before the fiber particles would pass. There was a four-way interaction (*P*<0.01) including the factors of *in vitro* run, time, fiber type, and corn bran addition. Fiber types did not have a consistent effect on buoyancy of the corn bran on incubation time or on the two *in vitro* runs. This could mean that the procedure is not accurate (precise) or that there are important biological interactions that need to be studied.

Net matte layer values were determined by calculating the difference of treatments containing corn bran minus treatments containing corn alone within each fiber type. While there were five matte layer measurements taken, the mid-point of 14 hours was chosen for representing effect of fiber types on corn bran buoyancy over time (Figure 2). Among the fiber types, alfalfa hay produced the greatest net matte layer, with corn silage and corn stalks being the lowest.

This modified lab procedure of measuring buoyancy with matte layers over time may prove useful to describe fiber retention and potential digestibility of corn bran and fiber types. However, when collecting rumen fluid from concentrate donor animals, there is a considerable amount of gaseous foam that contributes to the fiber buoyancy and calculated matte layers and this may cause variation among *in vitro* replications. The correlation between the new *in vitro* procedure and in vivo procedures has not been established. More research is needed to quantify and describe the results observed when using this procedure.

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