

# Breaking down fiber digestion for ruminant energy

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As an industry, we have evolved to rely heavily on harvested cereal grains to supply energy for growing and finishing cattle, as well as breeding animals in certain conditions. Because of the relatively high efficiency of energy capture from these sources, maximizing the utilization of them has been a major focus in the beef cattle industry. Through grain processing and proper diet formulation, we have become relatively proficient at utilizing cereal grains in beef cattle diets.

As the cereal grain industry has sought alternative uses for their products, greater demand has led to increases in both overall grain price and price volatility. Today's grain market has made efficient utilization of cereal grains even more critical, and has also led many producers to look for alternatives to grain feeding in order to replace at least some of the risk currently associated with grain use in beef cattle diets.

One advantage beef cattle producers have is the ability of the ruminant animal to utilize fibrous feedstuffs that monogastric (simple-stomached) animals cannot utilize efficiently. Additionally, there is an increasing supply of high-fiber byproducts from the grain milling industries that are well suited as feed for ruminant animals.

Because of high grain prices, it is presumed that, in the future, more cattle will be grown in grazing situations for longer periods of time prior to placement in the feedlot. (Although this year that hasn't been the case in many areas due to weather and other circumstances.)


With a potential greater reliance on higher-fiber feedstuffs comes a greater need for understanding how the ruminant animal works and how to maximize efficient use of feedstuffs by the animal. To accomplish this, there is a need for a basic understanding of the digestive tract of cattle and where digestion of certain nutrients occurs. For our purpose here we will focus on fiber digestibility and where it occurs in cattle.

## Defining fiber and breakdown

First we must define fiber, which I will describe as the carbohydrate fraction of the feed resistant to digestion by enzymes produced by cattle. To put it another way, cattle don't produce the enzymes necessary to break down fiber directly, so they must rely on microorganisms that do produce those enzymes to break it down for them.

However, cattle will aid those microorganisms through rumination and chewing to physically break apart the fiber. If microorganisms cannot break down the fiber, it passes through the animal intact and is unavailable to the animal as a source of energy.



One advantage that high-fiber byproducts have over cereal grains as supplements to forage-based diets is that they usually contain relatively small amounts of starch.  STAFF PHOTO.


Because of the reliance of cattle on microorganisms to break down fiber, the only two places in the digestive tract where any appreciable fiber digestion occurs are in the rumen and in the large intestine.

Generally, the amount of fiber digested in the large intestine is relatively small, although estimates have ranged from 5 to 30 percent of the total fiber digested. Because of this, improving the rumen environment has been the major focus for improving fiber utilization in beef cattle.


Additionally, when fiber is digested by microorganisms, some of the energy is captured in the microbial cells, and some is retained in volatile fatty acids produced by the microorganisms. If the fiber is digested in the rumen, the resulting microbial cells will pass through the rest of the digestive tract and be broken down for use by the animal as a source of protein and energy.


If the fiber is digested in the large intestine, the microbial cells will pass through the animal largely intact because the "machinery" to break them down is located in the gastric stomach and small intestine, which is obviously upstream in the digestive tract from the large intestine. Additionally, the rumen contains papillae that absorb the volatile fatty acids produced, so it is particularly well-suited for this purpose.

So the question then becomes how do we maximize rumen fiber digestion to make certain we are getting the most out of our feedstuffs? To do this we must manage the rumen environment so that it keeps the fiber-digesting bugs happy and healthy by:

 Providing adequate nutrients to support the growth and function of fiber-digesting


microorganisms. Providing adequate nutrients for the fiber-digesting microorganisms begins with making certain there is sufficient ruminal nitrogen available for them to utilize. In most instances, providing sufficient crude protein will accomplish this. There are other nutrients like branched-chain amino acids that will improve fiber digestibility, but the economics of their use remain unclear in many situations.

 Maintain a rumen pH that is optimal for the growth and functionality of fiber-digesting microorganisms. One advantage high-fiber byproducts have over cereal grains as supplements to forage-based diets is that they usually contain relatively small amounts of starch. The starch contained in cereal grains has a negative effect on fiber digestibility, presumably through the decreases in rumen pH that result from their rapid fermentation in the rumen. Because of this, limiting the use of starch-containing feedstuffs in forage-based diets will help improve fiber digestibility.

 Limit the use of other things that may impair fiber-digesting microorganisms. Corn oil has been shown to reduce fiber digestibility in forage-fed cattle. The polyunsaturated fatty acids contained in corn oil have a negative impact on the activity of fiber-digesting microorganisms. Interestingly though, the corn oil contained in distillers grains derived from corn has much less of a negative impact on ruminal fiber digestibility than corn oil. There seems to be some protection provided by the matrix of the distillers grains, so their use in forage-based diets is

limited much less by fat content.

Other ways to improve fiber digestibility are to properly process harvested forages and to use feed additives like certain active dry yeast strains to improve the rumen environment.

In conclusion, because the efficiency of energy capture from fibrous feedstuffs is becoming more important, understanding where fiber digestion occurs in cattle and what we can do to increase its utilization also becomes more important. Feeding cattle on forage-based diets in a way that also feeds the fiber-digesting microorganisms will help ensure they are getting the most out of the feedstuffs you are providing. 



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