

# Fact sheet



U.S. Dairy Forage Research Center  
USDA-Agricultural Research Service  
Madison, Wisconsin

## Rumen microbes: Take a closer look at these interesting creatures that both work for and feed dairy cattle

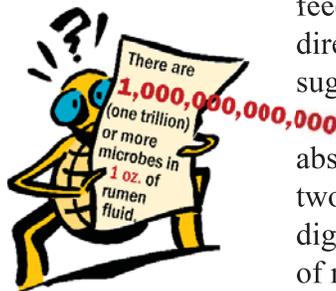
Rumen microbes could be considered a cow's best friend. Without microbes, a cow's digestive system would shut down and she would starve to death.

Cows and microbes actually have a mutually beneficial relationship. Microbes give the cow:

- labor to digest feed;
- a source of protein;
- a source of volatile fatty acids;
- the ability to digest forage.

On the other hand, cows provide microbes with:

- water;
- warmth;
- grinding (cut chewing) of feed;
- anaerobic (no oxygen) conditions.



There are three main groups of rumen microbes:

- **Bacteria** carry out most of the digestion of sugars, starch, fiber, and protein for the cow.
- **Protozoa** swallow and digest bacteria, starch granules, and some fiber.
- **Fungi** make up only a small fraction of the rumen microbial population, but they appear to be important in splitting open plant fibers to make them more easily digested by the bacteria.

### Many different species

There are probably thousands of species of rumen bacteria, but only two dozen have been studied in detail. It appears that each cow has her own population of rumen bacteria; this seems to vary more between cows rather than within one cow fed substantially different diets. Identifying microbial populations may provide clues to improving animal performance.

Almost all rumen microbes are anaerobic; they will only grow in an oxygen-free environment. New microbes are constantly being produced in the rumen

(under adequate conditions) while old ones are passed on down through the cow's digestive tract. One type of rumen bacteria can double its population in 11 minutes!

In many ways, when you feed your cow you're really feeding the microbes in her rumen. The cow cannot directly utilize most feed components, even simple sugars. She relies on rumen microbes to convert feeds to volatile fatty acids (VFAs) that the cow absorbs and uses to make energy and milk. About two-thirds of feed digestion and 90 percent of fiber digestion takes place in the rumen – all with the aid of microbes.

### Good source of protein

While rumen microbes help cows *digest* feed, they're also an important *source* of feed for cows. They're typically about 55 percent protein; on some rations the microbes provide half of the total dietary protein need of the cow. Even more amazing is the fact that rumen

microbial protein has almost the perfect mixture of amino acids – one that has not been duplicated in any ration. And rumen microbes are a particularly rich source of lysine and methionine, two amino acids that are difficult to supplement in dairy cattle rations.

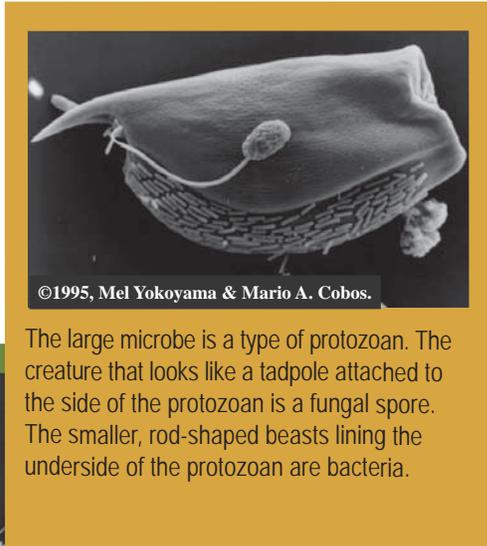
Most rumen bacteria attach themselves to feed particles, and fiber digestion will only occur by attached microbes. This allows cows and other



Photo by Lydia Joubert.

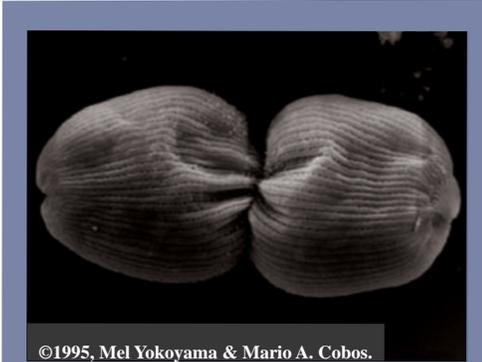
Bacteria attacking a strand of fiber that was taken from a cow's rumen.

ruminants to make use of feeds, like alfalfa and grasses, that people can't eat. Many of these plants are grown on land that isn't suitable for other crops. Thus, cattle produce food from land that might otherwise be under utilized. Cows are also useful consumers of by-products from human food production (like citrus or beet pulp) and from grain ethanol production (distillers grains).



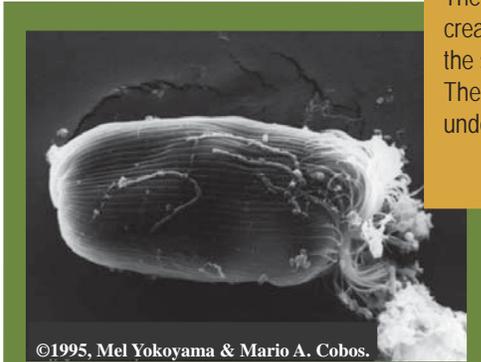
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The large microbe is a type of protozoan. The creature that looks like a tadpole attached to the side of the protozoan is a fungal spore. The smaller, rod-shaped beasts lining the underside of the protozoan are bacteria.



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Most rumen microbes, like this protozoan, grow by increasing their cell size, then splitting in half to make two cells. Under ideal conditions, most species of rumen bacteria can double their populations in a few hours.



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The hairy stuff on the outside of this protozoan cell is "cilia" – Latin for eyelash. These cilia wave back and forth and either propel the microbe through the water or propel food toward it. This protozoan has several chains of bacteria that are stuck to it.

Thanks to Dr. Mel Yokoyama of Michigan State University for use of the photos.



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This rumen protozoan is covered with chains of bacteria. Some protozoan and bacterial cells actually have a symbiotic relationship, each giving the other something that it needs to survive.



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This is one of the biggest rumen protozoa. Protozoal cells are much larger than bacterial cells; some can almost be seen with the naked eye.

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