Cattle Gut Microbe Series: Ruminococcus species

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The ruminant is a fascinating animal because of its ability to convert feed and forage into energy and microbial protein. This action is due to the animal's gut microbes, including bacteria, protozoa, fungi and archaea. The microbes of the rumen and lower gut have a large impact on the performance and health of their host animal. Many of these microbes are beneficial to cattle. However, other microbes may cause harm. Optimizing management strategies to improve performance and animal health monitoring relies on an understanding of these key microbes in the digestive tract and how they may impact your operation. This publication in the Cattle Gut Microbes Series will introduce and discuss microbes, or groups of microbes, that are important to cattle production.

Overview

Ruminococcus species are an anaerobic, spherical shaped, Gram-positive species of bacteria that are present in the digestive and reproductive tracts of cattle [Figure 1]. These bacteria are highly abundant and contribute to the digestive and reproductive health of the animal [1].

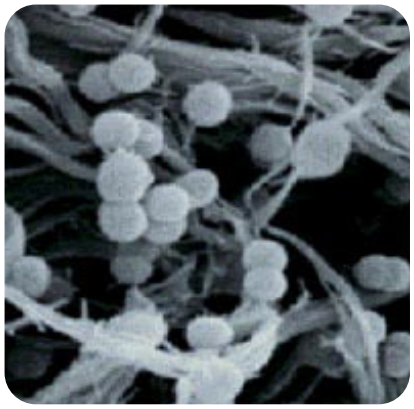
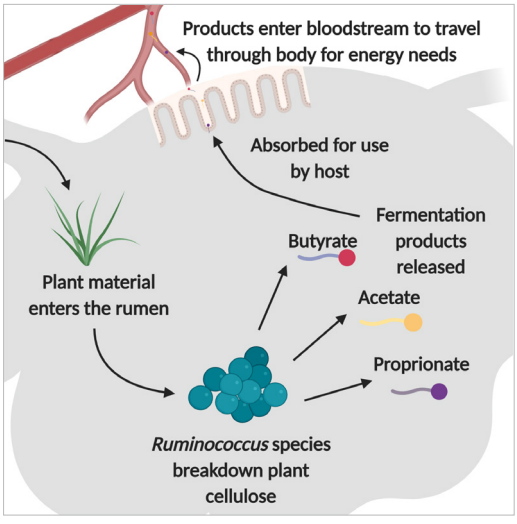


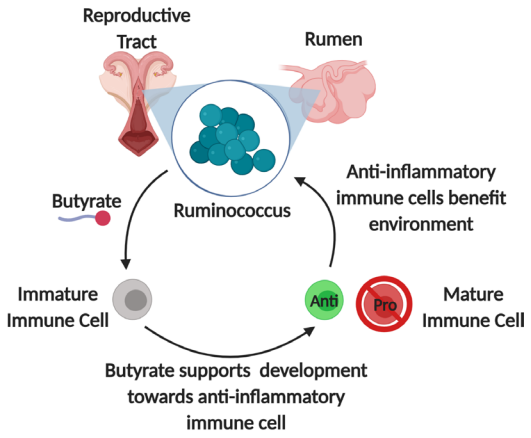
Figure 1. *Image of* Ruminococcus *organisms. Courtesy of Microbe Wiki and Mark Morrison.*



Description

The majority of *Ruminococcus* species in the rumen are cellulolytic, meaning they largely contribute to the breakdown of forages in the rumen. Specifically, cellulolytic bacteria breakdown cellulose, a component of the plant's cell wall that the animal could not utilize on its own. As the bacteria break down the ingested forages, they release volatile fatty acids as a product of fermentation. The main volatile fatty acids produced are acetate, propionate and butyrate. These products are then absorbed by the animal and converted to other substances that are used as main source of energy for the animal's needs [Figure 2].

Figure 2. Ruminococcus *breaks down plant-based feedstuffs to release fermentation products that are absorbed by the rumen wall to enter the bloodstream for use by the host. Image created using BioRender.*



Butyrate is the predominant volatile fatty acid produced by *Ruminococcus* species. Along with its uses for energy, butyrate is also important for immune system functions by regulating immune cell development and promoting anti-inflammatory effects [Figure 3; 2]. This regulation of inflammation is associated with the beneficial effects of *Ruminococcus* species by reducing excessive inflammation that can damage tissues in the gastrointestinal and reproductive tracts of cattle. *Ruminococcus* species are highly abundant in the vagina and uterus of healthy cattle and are thought to contribute to the reproductive tract environment that supports future breeding success [3].

Figure 3. *The* Ruminococcus *fermentation product butyrate is involved in developing immune cells for anti-inflammatory functions for healthy rumen and reproductive tract environments. Image created using BioRender.*

Take-Home Message

Species of *Ruminococcus* bacteria greatly contribute to the digestion of plant materials in the rumen. The production of volatile fatty acids, especially butyrate, benefit the ruminant animal by:

- Providing energy for maintenance, growth, and reproduction.
- Maintaining a healthy rumen and reproductive tract environment.
- Reducing tissue inflammation across organ systems.

Understanding how these bacteria influence cattle can help beef cattle producers provide optimal nutrition for maintaining animal health and optimal production in their herds.

If you have any further questions about microbes in your cattle operation, please contact Phillip Myer or visit rumenmicrobes.utk.edu. As always, consult with your county UT Extension agent for more information.

References

1. La Reau AJ, Suen G. The Ruminococci: key symbionts of the gut ecosystem. *Journal of Microbiology.* 2018/03/01 2018;56(3):199-208. doi:10.1007/s12275-018-8024-4
2. Furusawa Y, Obata Y, Fukuda S, et al. Commensal microbe-derived butyrate induces the differentiation of colonic regulatory T cells. *Nature.* 2013/12/01 2013;504(7480):446-450. doi:10.1038/nature12721
3. Appiah MO, Wang J, Lu W. Microflora in the Reproductive Tract of Cattle: A Review. *Agriculture.* 06/17 2020;10:232. doi:10.3390/agriculture10060232

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