

Fact sheet



U.S. Dairy Forage Research Center
USDA-Agricultural Research Service
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Intensive Animal Nutrition Research: Unlocking rumen secrets for more efficient utilization of dairy cattle diets

Here at the U.S. Dairy Forage Research Center we are charged with building a base of knowledge and technology to help the dairy industry fully exploit the use of forages in the production of milk. While forages are essential to ruminant diets, they have their challenges – mainly fiber digestibility and protein utilization.

When ruminants cannot make full use of the nutrients in forages, it costs farmers in terms of lost milk or meat production. It also affects the environment: More manure (unused fiber) for disposal; and unused nutrients (such as nitrogen and phosphorus) finding their way into the environment.

In order to achieve more precise knowledge on how cows and other ruminants digest forages, we must first gain a better understanding of what happens inside the rumen – that marvelously complex first compartment of a cow's stomach. Hence, the need for an Intensive Animal Nutrition Research Facility.

What is an Intensive Animal Nutrition Research Facility?

An Intensive Animal Nutrition Research Facility provides a very controlled environment in which to conduct trials on an individual cow basis. With it we can automate and monitor feeding rates and refusals; collect all milk and manure to record the amounts and analyze the nutritional content; collect gaseous emissions from the animals; and more.

What is it designed to do?

An Intensive Animal Nutrition Research Facility would contain both animal and research laboratories with the capacity to:

- conduct digestibility trials;
- monitor feeding and chewing behavior;
- continuously collect ruminal pH and motility data;
- and sample ruminal, duodenal, and ileal digesta on 24 lactating cows simultaneously.

It would also add capacity to conduct digestion trials with small ruminants (such as sheep) to obtain intake

and digestibility information on novel or advanced forage germplasm when amounts of plant material are inadequate for lactating cow experiments; this would shorten time and reduce money needed to produce new forage crop varieties.

Why should we learn more about the rumen?

Ruminants produce nearly all of the milk and about 32 percent of the meat (including poultry and fish) consumed in the U.S. They take crops and byproduct feeds that

humans can't use and turn them into protein and other nutrients needed by humans. Agricultural producers, nutritionists, and researchers are constantly looking for more efficient ways to convert feed to milk and meat. They need new data and research methods to further advance this area of study.

New data needed for ration balancing

Today's rations are balanced with digestion data that were created 30 to 50 years ago when feed ingredients were different, cows weren't producing as much milk, and the nutrient content of manure wasn't an issue. But there is no industry-wide effort underway to systematically update digestion data.

Environmental concerns

When dairy cattle can't use all of the nutrients that are fed to them (either overfed or unavailable), the excess comes out in the manure. When this manure is applied to the land as fertilizer, these excess nutrients may end up as ammonia in the air, nitrates in ground water, or phosphorus in surface water.

The DFRC is researching ways to use more protein (nitrogen) and phosphorus for making milk, not



manure. One way is to redesign forage plants for improved digestion and protein utilization. But first we must better understand how cows digest forages so that plant breeders can know what changes to make in plants. Another way is to improve methods of ration balancing. Again, we must better understand what happens in the rumen.

Feeding more byproduct feeds

By consuming byproducts from the food, fiber, and bioenergy industries, dairy cattle convert a large portion of a potential landfill waste into milk. Now the nation's push to produce more biofuels is creating a mountain of additional byproducts.

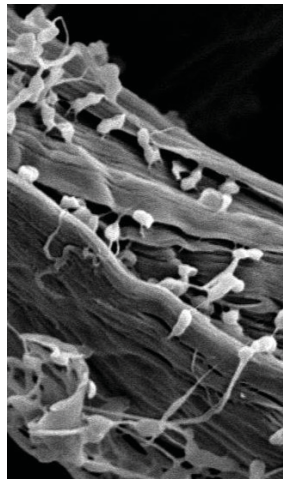
If dairy cattle are to continue to serve as efficient recyclers of byproducts, we must have a better understanding of how these feeds are digested; this information could help us find ways to modify the production of the end products and/or treat the byproducts so that they can best be incorporated into livestock diets.

Why can we learn more today?

Today we have technology that we didn't have 30 to 50 years ago when digestion data was first collected.

- We can use genetic markers to track the populations of ruminal bacteria that are responsible for digestion.
- We can monitor digestive activities (eating, drinking, chewing) as well as blood chemistries on a minute-to-minute basis.

An Intensive Animal Nutrition Research Facility would help us to use these new technologies to gain new knowledge and data.



Rumen bacteria attacking a strand of plant fiber.

What do we want to learn?

Fiber digestion

- How is fiber digested?
- What affects the rate and extent of digestion?
- Which rumen microbes are important?
- What improves the microbes' ability to digest fiber?

Rate of passage

- As cows eat more, digestibility decreases; many high-producing cows are eating so much that they don't adequately digest their feed. Is there anything we can do to improve digestion at high levels of intake?
- Does the way that cows eat – i.e., 'nibblers' vs. 'gobblers' – affect passage and digestion?

Ration interactions

- Why does feeding too much of some ingredients, like corn, reduce forage digestibility?

How will unlocking the secrets of the rumen help improve our world?

- A cleaner environment.
- More perennial forages in the landscape to reduce soil erosion and improve soil health.
- Healthier cows.
- More sustainable, profitable milk production.



More background information . . .

Adding an Intensive Animal Nutrition Research Facility and the resources to effectively operate it would help the U.S. Dairy Forage Research Center to meet the following objectives:

- Provide basic knowledge about the factors that limit the intake and digestion of forages.
- Develop strategies to optimize forage utilization in dairy cow diets and minimize the negative effects of ingredients in the diet that limit forage utilization by dairy cows.
- Increase the accuracy of forage evaluation and improve the formulation of dairy rations that increase profit, improve animal health, and reduce manure excretion.
- Develop strategies to minimize the environmental impact of land-applied manure from dairy cattle, such as reducing ammonia emissions or reducing the excess nutrients that find their way into surface and/or ground water.
- Create an integrated system for evaluating novel forage germplasm that increases the rate of development of high intake and digestibility forages that improve the productivity, health, and longevity of dairy cattle.
- Improve the nutritional quality of forage plants through genetic selection and molecular genetics.

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