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Impact of Dairy Farms on the Environment: Feeding Strategies to Reduce Nitrogen Excretion

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Nitrogen is the main component of amino acids, which are building blocks used for protein synthesis in plants and animals. Proteins are molecules involved in all life aspects; a cow's requirements for protein vary with the life stage and milk yield. Proteins are essential to optimize milk production and overall health and are an important part of dairy products. Because of that, protein is essential in dairy cow's diet; the primary protein sources include forages (alfalfa and grasses) and concentrates (soybean meal, distillers' grain, and others). However, cows cannot obtain protein straight from a feedstuff; all feed protein will be first degraded to amino acids, then absorbed and used in protein synthesis by the cow. Therefore, cows have requirements for amino acids, which can be obtained from 1) amino acids from a feedstuff or 2) amino acids synthesized by microorganisms in the rumen. In the second scenario, microorganisms can synthesize amino acids with simple nitrogen molecules or low-quality protein sources, supplying up to 80% of cows' requirements. Adequate forage and a balanced diet are necessary to optimize rumen function.

Protein is comprised of approximately 16% nitrogen. Nitrogen is also present in urea and ammonia which microbes use in the rumen, but can then be excreted in manure (feces and urine). Because of this, we generally evaluate cows' protein metabolism with dietary nitrogen efficiency. Dietary nitrogen efficiency is calculated based on the proportion of nitrogen intake used for milk production and growth versus what is excreted in manure. For dairy cows, the proportion that goes to milk can vary from 20% to 35%; about 2% is used for growth, and 63% to 78% is excreted as manure, which results in approximately 27% nitrogen efficiency. Nitrogen in manure can turn into potent greenhouse gases or leach into water bodies, mainly if it is excreted in the urine and mixed with feces.

Manure can be used as fertilizer for crops that feed cows (silage corn or pasture); in doing so, nitrogen is reused by cows. Manure management can improve nitrogen efficiency to 64% when considering nitrogen efficiency at the farm level. However, the level of fertilizer used for crop production is critical to ensure adequate production without affecting soil contamination. The nitrogen excess in the soil negatively affects nearby water sources because it can lead to algal blooms and depletion of water oxygen levels.

Precision feeding and dietary supplementation are feeding strategies that focus on environmental considerations such as nitrogen management and reduced feed costs. There is significant room for improvement in nitrogen use due to the wide range

of nitrogen efficiency. Therefore, adjusting dietary composition is an effective strategy to improve the dairy industry's sustainability. A diet that optimizes rumen function and provides balanced amino acids improves dietary nitrogen efficiency, reduces nitrogen environmental excretion, and reduces feed costs. This feeding strategy is widely applied in large herds due to the availability of technical assistance. The same application on small farms is limited due to a lack of access to technical assistance. For this reason, we proposed an extension project to improve knowledge of the current situation regarding the nitrogen efficiency of Virginia-Maryland dairy farmers and support the producers of these states.

The extension project “Dietary Strategies to Protect Waterbodies and Enhance Sustainability Practices on Nitrogen Use by Dairy Farmers” received support from the National Association of State Departments of Agriculture (NASDA) and will encompass different phases. Initially, we propose a survey for dairy farmers, encompassing questions about farmers' profiles, property size, herd, nutritional practices, and sustainability practices related to manure waste and its destination. This approach will be used to generate data about the status of the properties that will be used in the following phase.

A few farmers participating in the first phase will be visited to evaluate nitrogen use and recycling on the farm and assess the risk of water contamination. We will develop a plan for these farmers to provide technical assistance to reduce the risk of water contamination from nitrogen excretion. A specific dietary strategy will be developed based on dietary feedstuff and farmers' goals to improve farm sustainability and profitability. A continuous assessment of nitrogen use efficiency will be performed throughout the year. As the project's final output, we aim to hold a Field Day, integrating the whole community, to share the progress made in knowledge and environmental conservation practices obtained from this project.

With collaborative efforts and knowledge dissemination, we aspire to establish a paradigm shift towards more sustainable and efficient dairy production practices. Thus, we kindly invite you, dairy farmers, to contribute to our research by completing the survey by accessing the link below or reading the QR code.

https://virginiatech.questionpro.com/t/AaOPeZ1RQg

DAIRY FARM SURVEY

FLOWCODE PRIVACY.FLOWCODE.COM

SCAN ME

We appreciate your commitment to advancing dairy farm sustainability. Together, we can pave the way for a brighter future in dairy farming.

News from the Forage Quality and Management Program

Authored by Gonzalo Ferreira, Ph.D., Associate Professor & Extension Dairy Scientist, Dairy Management, School of Animal Sciences, Virginia Tech; gonf@vt.edu

The Forage Quality and Management Program at Virginia Tech has made substantial progress in the last few years, and soon we will translate this knowledge into practical information for dairy farmers. In the meantime, this article describes some of our accomplishments as an advance.

In 2023, we finished analyzing the samples of our plot study evaluating the effect of maturity at harvest on forage quality for silage. For this study, we planted two varieties of barley, two varieties of rye, and four varieties of triticale in Blacksburg, Blackstone, and Orange, and we harvested all varieties at both the boot stage of maturity and soft-dough stage of maturity. It is worth highlighting that we replicated the study over two years, so we harvested all the varieties during 2021 and 2022. Harvesting at the soft-dough stage of maturity resulted in greater biomass yield than harvesting at the boot stage of maturity, and we expected this observation. Harvesting at the boot stage of maturity resulted in forage of better quality than harvesting at the soft-dough stage of maturity, and the higher concentration of crude protein, the lower concentration of fiber (NDF), and the higher digestibility of the fiber explained the better quality. Surprisingly, the forage quality made a minimal difference in feeding costs when we formulated rations using a least-cost formulation approach. We are still evaluating the implications of this study. However, agronomical factors seem more relevant than nutritional factors when deciding when to harvest small grains for silage. We thank the Virginia Agricultural Council and the John Lee Pratt Animal Nutrition Program for supporting this research.

Measuring the passage rate of feeds from the rumen of lactating dairy cows is another milestone of our research program. We have been evaluating this area for years, and Hailey Galyon has finally refined the technique so we can obtain reliable data. In this area, we observed that the fiber of the feed escapes from the rumen faster for cows consuming alfalfa-based diets than for cows consuming grass-based diets. Interestingly, cows consuming alfalfa-based diets digested the dietary fiber more efficiently than cows consuming grass-based diets. We consider this an important milestone, and soon we will start a new study evaluating the effects of forage quality on ruminal passage rate. In this case, we thank the National Alfalfa & Forage Alliance for supporting our research.

Another milestone, for the College of Agriculture and Life Sciences rather than our program, is the acquisition of a GreenFeed system for measuring methane emissions from cattle. As a follow-up, we performed our first feeding trial linking forage quality and methane production last semester. For this, we measured the methane production of cows consuming diets containing silage of triticale harvested at either the boot stage or soft-dough stages of maturity. Interestingly, we observed that cows consuming diets containing late-maturity triticale silage produced more methane than cows consuming diets containing early-maturity triticale silage. Once again, we thank the John Lee Pratt Animal Nutrition Program for funding the research and the equipment.

On top of all these accomplishments, there is more to come. Next semester, for example, we will perform a new and challenging study integrating forage quality into the ruminal digestion kinetics (i.e., rate of passage) and methane emissions from lactating dairy cows. Although slow, our steady progress gives us confidence that impactful knowledge will emerge from our Forage Quality and Management Program.

Upcoming Events

April 13, 2024
Hokie Dairy Day (Youth)

April 27, 2024
Little All-American
Blacksburg, VA

May 3, 2024
Dairy Skillathon (Youth)

May 4, 2024
VA Spring Holstein Show

May 13, 2024
Hokie Cow Classic

June 8, 2024
Franklin County Livestock Show with Dairy

July 8-11, 2024
Southeast Youth Dairy Retreat
Florida

August 1, 2024
State Dairy Judging Contest (Youth)

If you are a person with a disability and require any auxiliary aids, services or other accommodations for any Extension event, please discuss your accommodation needs with the Extension staff at your local Extension office at least 1 week prior to the event.

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