nitrogenhoardsarticle

Air and water quality issues will influence how rations are formulated for protein.

By Virginia Ishler and Gabriella Varga
Extension Associate and University Distinguished Professor at Penn State University

Water quality has been the main focus of environmental regulations with phosphorus gaining most of the attention. Air quality issues are next in line in the regulatory process. Therefore nitrogen is as important as phosphorus, and maybe even more so, because water and air quality issues are strongly influenced by this element. Odor problems are moving to the forefront of public concerns. It is highly probable that odor management plans will be required in the future similar to how nutrient management plans are already in place.

The efficiency of nitrogen utilization is typically low in dairy cows. For example, dairy cattle on average secrete between 25 to 35 percent of the nitrogen consumed into milk and the majority of the remaining nitrogen is excreted in manure as ammonia and organic nitrogen. Some reasons why nitrogen efficiency tend to be low in dairy cattle is due to the practice of feeding protein in excess of requirements, improper balance of the protein fractions, and protein sources of insufficient quality and potentially limiting amino acids. Reducing dietary protein in the ration has been successfully achieved without reducing animal performance and can increase nitrogen utilization.

Urea, which is a major end product of nitrogen metabolism, is mostly excreted in urine with some diffusion into milk. In manure, the conversion of urea to ammonia is influenced by urease activity, pH and temperature. Ammonia emissions can be the cause of acid rain, odor nuisances, and it can react in the atmosphere with other trace gases eventually affecting particulate matter. From a nutritionist point of view, understanding how nitrogen impacts the environment and the probability of producers facing air quality regulations should be an incentive for improving protein nutrition on the farm.

Ammonia emitted into the air can contribute to the formation of acid rain. This is an environmental concern because of its impact on the ecosystem. Changes in pH can affect the biodiversity of fish, plant and other organisms living in an aquatic environment. As lakes and streams become more acidic, the numbers and types of aquatic life can decrease. Atmospheric nitrogen depositions on or near water sources can be significant. So not only can nitrogen leach into groundwater, but it can affect surface water by atmospheric deposition.

There is a great deal of information related to odor, but the methodology to quantify odor with specific elements and its effect on human health is lacking. Not only is there the actual odor, but there is an individual's perception of smell. Certain smells can overlap with emotions. For example, an unpleasant odor can affect a person's mood. Odor may prompt an unpleasant memory. There may be a preconceived perception about the type of facility from which the odor is emanating. Every person has a different threshold as to what they consider an offensive smell. Another unknown is the association between odor and health. There have been reports of people experiencing nausea and depression due to

odors emanating from swine facilities. The question that gets asked, “Is it real or is it psychological?” The other issue, which is more tangible, is how odor impacts the quality of life and property value. There are several practices that producers can follow to promote a positive environment.

Since the general public tend to associate a visual picture with odor, maintaining a clean, neat, aesthetically pleasing facility would go a long way to improving a person’s perception. Injecting or incorporating manure shortly after application, early in the day if possible, would minimize odors. Farms near residential areas should avoid manure application on holidays and the weekend. Communicating with neighbors can go a long way in fostering better relations and minimizing complaints.

Consider odor management when planning a herd expansion and examining options for new facilities. Site selection can be a critical factor in relation to prevailing wind and residential areas. Work with engineers to evaluate options to reduce manure surface area exposed, dust control, capture and treatment of gas emissions, dilution of emissions, or manure treatment. Keeping odor in mind when making plans may save a lot of aggravation and grief in the future.

An upcoming problem area for the animal industry relates to the synergistic effects between ammonia and particulate matter (PM). Particulate matter refers to microscopic particles that can enter into the lungs and cause a variety of respiratory problems. These particulates are 10 microns or less in size. In agriculture, this would include dust and smoke particles. Even smaller particles, less than 2.5 microns ($PM_{2.5}$) in diameter ($1/8^{th}$ the diameter of human hair) can penetrate more deeply into the lungs. Ammonia becomes very important because it can react with trace gases such as nitrogen and sulfur oxides to form fine particles, which can combine to form aerosols. Ammonia is a precursor to the formation of $PM_{2.5}$ which would be subject to regulations.

It is estimated that nitrogen loss to the atmosphere from livestock production operations can be as high as 70% of the nitrogen fed. This makes nitrogen and the animal industry a high priority area. The industry is faced with not only controlling phosphorus for water quality, but nitrogen for both water and air quality. What can be done nutritionally to better control the excess nitrogen being excreted by dairy cattle?

The first step is to change the mind set that more is better. This has been a common philosophy with not only phosphorus feeding but also crude protein. Dairy cattle do not have a crude protein requirement per se, but rather a requirement for metabolizable protein. Nutritionally, excess nitrogen comes from feeding nitrogen in excess of requirements, feeding excessive amounts of rumen degradable protein, and improperly balanced diets for degradable and undegradable protein, amino acids and energy. There are many computer models available to evaluate and formulate diets for metabolizable protein. These models are an excellent tool to fine-tune protein nutrition.

The nutritional status of the lactating herd can be monitored using milk urea nitrogen (MUN) analysis. MUN testing can be an important tool as nutritionists strive to formulate

rations closer to recommended levels of metabolizable protein and amino acids. However, the entire burden of controlling nitrogen in the ration should not rely solely on formulated paper rations. There are several feeding management practices that can be implemented to improve nitrogen utilization on the farm:

1. Improved forage quality should lead to improved digestibility. This allows more forage to be fed in the ration and reduces imported nitrogen to the farm.
2. Routine forage and feed testing for crude protein and the protein fractions can help maintain precision feeding of protein.
3. Matching carbohydrate and protein sources to lower rumen ammonia levels has the potential to improve dietary nitrogen utilization and reduce nitrogen excretion. Several computer models are available that can evaluate nutrient quantities (and degradation rates).

Many of the basic feeding management practices that have been taught over the years to improve animal performance will now be important tools for accountability in water and air quality regulations. It is never too late to be proactive and examine more closely how rations are being formulated for protein. More information on nitrogen management can be found at http://nutrient.psu.edu