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The use of milk urea nitrogen (MUN) as a management tool

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Anyone who has priced soybeans lately is well aware of how expensive they are. Their high cost is making it necessary for many dairy producers and nutritionists to look for protein substitutes.

Because of the high price of protein for dairy rations, it is absolutely necessary to make sure the cow is utilizing the nitrogen in that protein to its fullest extent. Wasted protein in a dairy ration is not only costly, but creates an environmental strain that should be avoided or minimized.

There are few practical ways to evaluate how well the ration is being utilized by the cow. However, one exception is the milk urea nitrogen (MUN) test. I request this test for all dairy producers I work with, and would like to share some of my observations as well as recent research that can make this test more useful for you.

Machine Accuracy

The MUN test is easy to run, samples are easy to collect, it is non-invasive, and results are quickly available. Recent work from Maryland (for a listing of machines and how they ranked see: *J. Dairy Sci.* 87: 1747 and 1848 (2004)) showed there are differences in accuracy of the reading depending on the machine used to analyze the milk sample.

My first take-home message is that if the accuracy of the MUN value is important to you, find out what make and model of machine is being used to analyze your sample. I have had several conversations with dairy producers about results they obtained from DHIA compared with results from their processor. Even if you were only looking for relative changes in MUN concentrations, I would still prefer a more accurate reading, even though having any reading in hand is preferable to no reading. Also, the other components in milk, such as fat percentage, may influence your values depending on the machine making the reading.

Again, go for the best if possible.

Relationship with ration crude protein percent

Recent research from Europe has shown a linear relationship between MUN and ration protein content. The practical use of this is to use MUN to determine the CP content of feed actually consumed and metabolized. If there is a significant difference between the ration analysis of CP and the CP as measured by MUN, then it suggests that the utilization of the feeds by the cow is not matching the analysis.

I have tried this on several dairies, and for those with high MUN this relationship holds true. For herds with lower MUN, the MUN seems to underestimate the level of CP in the ration as measured by laboratory analysis. Obviously there are other factors that we need to take into account. One such factor would be body weight of the cow.

While there hasn't been a lot of research in this area, there is enough to suggest that body weight of the cow can influence MUN concentration. Heavier cows seem to have a lower MUN concentration, all other things being equal. It would be interesting to follow through with this and see if the MUN is lower, but the milk protein percentage is not different for heavier cows, suggesting that the increased efficiency of dietary protein usage is going into body mass rather than production.

The take-home concept is that as the ration protein content increases, MUN increases, urinary nitrogen waste increases, and efficiency of protein utilization as measured by milk protein percentage decreases. The European researchers mentioned above and work that I did confirm these associations. The key, in my mind, is to use MUN in conjunction with milk protein percent. The worse case scenario would be to have a high MUN and a low milk protein percentage. This says the cow is utilizing the protein in the ration very poorly.

Other uses of the MUN test might be to evaluate mixer wagon performance. I know of one dairy producer who had three pens of animals that all received exactly the same ration and were all fed from the same load.

When he looked at the MUN concentration average for each pen he noticed they were all different and changed in a linear manner between the three pens. When he started to look into it he found the knives on his mixer wagon were worn down or missing and he was not getting a uniformly mixed load. One pen was getting a high forage amount, one was just right, and one was getting a high concentrate amount. The average of all three pens looked good, but obviously something was not right. He repaired his mixer wagon and all three pens started to get the same ration.

Monitor forage changes

Another use of MUN is to monitor changes in forage lots. I had one dairy producer who was consistently having a MUN test done each month at his DHIA test. One month the results came back significantly higher than they had been historically. The only thing he had done differently was to open a new bag of haylage and use it at the same level as the previous bag. However, the protein content of this bag of haylage was significantly higher than the previous bag, making his MUN go up. After analyzing the haylage he made the appropriate changes to his ration and MUN levels came back into line.

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I also like to monitor bulk tank MUN concentrations and have found it to be an extremely good indicator of major ration changes. Sometimes the changes do not occur when you predict them. I know of one dairy that made changes to the ration and the MUN did not fluctuate. Several weeks later he made a small forage change that seemingly was not a major item and the MUN changed significantly.

The bottom line is that you need to monitor the changes in order to determine their effect.

Reproductive problem

There have been many research articles that show a decrease in reproductive efficiency when MUN is high. Several recent articles also show similar trends; however, the effects seem to be most prevalent during the 60-90 DIM window and taper off after that.

A high MUN is associated with an increased energy demand on the body to detoxify ammonia in the blood stream and convert it to MUN. Research has shown that urea in the uterus can create an environment unfavorable for the embryo. I think that diversion of energy away from body needs at the same time as the animal is in a negative energy situation has an adverse impact on reproduction.

If MUN concentration is high and reproduction is suffering in early lactation, I check body condition score of the cow first. One dairy producer I know had MUN concentrations so high that animals were dying and reproduction suffered tremendously. By the time he got it under control he had lost well over $50,000 on his 80-cow operation. I don't see negative reproductive effects in all cases, but if the cows are skinny with high MUN, that is where I start.

The MUN test can be very useful for monitoring changes on your dairy. I hope you give it a try and monitor over a one-year period of time. It will be money well spent.

Understanding anaerobic lagoons: the key to good management

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A lagoon is a lot more than a manure pit. When a lagoon is managed correctly, it becomes a biological treatment device! But to make your lagoon a treatment device depends on an active population of anaerobic microorganisms. Your job is providing an environment where the microorganisms can thrive.

Lagoons have many advantages. They provide both manure storage and treatment and are low cost. Properly functioning anaerobic lagoons decompose solids and reduce oxygen demand, resulting in less sludge and making the effluent easier to irrigate with. Nitrogen concentration in effluent is also reduced, which decreases the land base needed for effluent application.

Everything has its disadvantages, of course, and lagoons are no different. They have a high land requirement, as well as design and management requirements to optimize their function. Periodic addition of clean water may also be required to maintain the lagoon treatment volume, and there are some environmental risks from odor, overflow, and seepage.

2-stage microbial breakdown process

Before making plans for managing a lagoon, it is important to understand the process that occurs in a well-functioning lagoon.

Microbial breakdown that occurs is a two-stage process. In step 1, acid-forming bacteria break down carbohydrates, proteins and fats, and release organic acids. These bacteria are widespread in the environment and multiply rapidly in response to a food supply. In addition to organic acids, ammonia and sulfur compounds are released in this process, contributing to lagoon odors.

In step 2, methane-forming bacteria convert the organic acids into carbon dioxide and methane gases, creating the bubbles you see in an active lagoon. Methane-forming bacteria are more sensitive than acid-forming bacteria. They are especially sensitive to low pH and to temperature changes.

A balance between acid formation (step 1) and conversion to gases (step 2) is crucial in the microbial breakdown process. Without this balance, acid buildup from the acid-forming bacteria can kill off the methane-forming bacteria.

Because methane-forming bacteria are so sensitive to pH and temperature, it is critical that dairies optimize these properties in their lagoons. If organic acids accumulate they can inhibit the methane-forming bacteria. Once the methane-formers are inhibited, pH continues to drop and the situation gets worse.

Temperature is the other critical factor, but this depends more on local climate than management. In areas with colder climates, anaerobic decomposition ceases in the winter. Manure is stored through the winter until the temperature rises above 40° F and bacterial activity resumes. Solids build up in the lagoon over the winter and when they get processed by the bacteria in the spring, odors increase.

In addition to pH and temperature effects, some compounds can also inhibit anaerobic bacterial digestion. In particular, copper has been shown to inhibit bacteria. This is why it is so important that copper from footbaths not be allowed to make its way into lagoons. This may also be true for other disinfectants.

A lagoon has several layers. At the bottom is the sludge layer. Treatment volume is the next zone and this is where most of the bacterial treatment actually occurs. The minimum height of this zone is six feet from the bottom of the lagoon.

If treatment capacity is adequate, sludge will probably only accumulate to a maximum depth of around two feet. If decomposition is inhibited, inactive sludge will invade the treatment volume, causing odor problems and reducing treatment effectiveness. Reduced treatment effectiveness increases sludge accumulation even more, and the lagoon fills up with sludge.

Sizing the treatment volume is based on climate due to the critical influence of temperature on the bacteria. A colder climate needs a larger volume. Larger lagoons emit less odor and improve effluent quality due to more optimum conditions for bacterial degradation. In addition, deeper lagoons have more stable temperature and better mixing.

Optimal lagoon function depends on good management during start-up as well as under normal operation. When a new lagoon is first put to work, odor problems are often a concern. To minimize odor the lagoon should be filled up to the treatment volume with water before adding effluent, otherwise overloading is likely to occur.

If possible, it's best to start up a new lagoon in late spring or early summer. If it's not possible to start up the lagoon at this time, it may be necessary to "seed" the lagoon with sludge from a well-functioning lagoon.

Managing water level is critical

Under normal lagoon operation, managing the water level is one of the most important maintenance chores. The engineer who designed the lagoon should mark the top of the treatment volume. Don't pump below this level! If surface rain water runoff is allowed to flow into the lagoon as well, another marker should be used to indicate the lower level of the runoff volume. Keep the water level between these levels.

If you pump below the treatment volume, the lagoon will be overloaded and odor will get worse. You may be tempted to pump below this level to increase storage space, but don't do it! This will result in an overloaded lagoon with a bad smell.

Be sure to monitor pH of the lagoon on a weekly basis. You can use simple paper test strips available from pool supply stores, or you can purchase a hand-held pH meter.

If pH drops below 6.5 you either need to reduce loading (may be impractical if you don't have another lagoon to divert effluent to) or add lime to raise pH. Add one pound of hydrated lime per 1,000 square feet of lagoon surface area. Then measure pH the following day and repeat the lime treatment if pH is still too low.

Sludge removal is a normal maintenance chore that usually has to be done every 5 to 10 years. Whenever sludge fills up half of the treatment volume it's time to dredge the lagoon. Be careful not to damage the liner, and be sure to leave some sludge behind to "reseed" the lagoon. Then fill the treatment volume back up with water before filling the lagoon with effluent again.

Management and maintenance are critical to a well-functioning lagoon, so don't treat your lagoon like a manure pit.

Western Dairy News is published as a service to people interested in the health and welfare of the Western dairy industry. Archives of this publication may be found at:
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