



MUNs - It's only a Piece of the Puzzle !

With the recent introduction of **milk urea nitrogen (MUN)** testing by Ontario DHI, there has been some confusion over the interpretation of the new reports. This article is meant as a complete guide to assist you in understanding and applying the results of MUN testing.

MUN testing has been available for the past 15 years but only recently has MUN analysis been conducted using Near Infra-Red (NIR) technology. This same machine is also used to determine milk protein, fat, and solid percentages for routine DHI component testing. Ontario DHI launched the MUN service by offering DHI customers 1 free MUN herd test and charging \$0.25 / cow / test for subsequent tests. The test is done using the same milk sample for milk component analysis and the entire herd must be tested. A brief pamphlet and article on MUN testing were mailed to all producers during the introduction of the service.

Initially, DHI field service reps were recommending MUN levels be between 10 and 14 for herd averages and were discussing the relationship between high MUNs and poor conception rates and early embryonic deaths in some herds. This relationship, however, is subject to some dispute in both the literature and from field reports.

It is important to understand the physiology of rumen protein degradation and what influences that rumen microbial protein production before making any changes to the herd's nutrition program, based on information from MUN reports.

The rumen degradable protein portion (DIP) of the cow's ration are broken down to peptides and amino acids by the rumen bacteria and used to make microbial protein with rumen - available energy. Some of these amino acids are further broken down to sugars and free nitrogen, which is quickly converted to **ammonia**. Most fibre digesting bacteria use ammonia as a nitrogen source to make additional microbial protein. Excess ammonia that accumulates in the rumen is quickly absorbed across the rumen wall into the bloodstream, where it is brought to the liver and converted to **urea**. It is then transported to the kidneys and eliminated from the body in urine. The process of converting ammonia to urea and eliminating it requires additional energy expenditure which increases the cow's maintenance requirements. Urea is able to cross most cell membranes and so when blood urea nitrogen (BUN) concentrations rise there is also an increase in urea levels in all tissues, including the mammary gland. This is why MUN can be used to estimate the overall levels of urea that are being produced by the liver and being excreted.

Some of the early MUN work showed that high protein diets were associated with high MUNs, although this was not a consistent finding in all studies or all cows in the same trial. Several reports also showed that there was a positive relationship between high MUNs (> 16) and poor reproductive performance in some dairy herds. Researchers have also shown that embryos and sperm do not survive in lab conditions when high

urea concentrations were added and used this data to explain why high MUNs resulted in poor conception rates and early embryonic deaths. This view has not been consistent across all trials that have looked at this association. In fact, one trial involving 2 groups of 1st calf heifers, divided into high and low MUN levels, showed that the high MUN group had better reproductive performance than the lower control group. This trial, along with Ontario dairy herd examples with high MUN levels and good reproductive performance, illustrates the point that we are still unsure about high concentrations of urea get in the cow's uterus and how uterine fluids protect the young embryo. The net result of these studies is that most researchers and veterinarians are hesitant to suggest a strong relationship between consistently high herd MUN levels and poor reproductive performance in a dairy herd.

The article that was sent out to the producers by Ontario DHI suggests that high MUNs may be indicative of excess rumen degradable protein levels in the ration and additional ration costs that are not needed. There is little dispute that MUN levels are an accurate measure of the level of urea being excreted from the body and therefore an indirect measure of the ammonia production in the rumen. There are several points that contradict the claim that high MUN levels are a result of high ration protein levels :

- 1) Time of Sampling vs. Feeding - Ammonia production in the rumen is not constant and is dependent on the fluctuating levels of feed and nutrient fractions that are degraded in the rumen. This fluctuation is also evident in BUN and MUN levels as well. Figure 1 is a graph which shows the variability of both BUN and MUN measurements in a herd fed a single feeding of a TMR but allowed access to the feed all day. As you can see, the time of sampling compared with the MUN level is highly related, with peak values occurring 3 to 4 hours after the main feeding. This graph also illustrates that the same cow can have MUN levels between 12 and 20 on the same diet, due solely to time of sampling. This can be an issue when herds are on the AM/PM sampling program by DHI and very different MUN results are seen between 2 tests. This further emphasizes the point that at least two tests should be done on the herd prior to taking any corrective action with the nutritional program.
- 2) Rumen Physiology - As discussed previously, high ammonia levels can result from high DIP levels, **but only if there is a lack of rumen available carbohydrate** for rumen microbial protein production. The addition of rapidly degradable energy sources, such as barley, wheat or Purina's Extrupro products, act like a sponge for some of this free ammonia in the rumen, resulting in more rumen microbial protein production and increased rumen efficiency. Figure 2 shows how the rumen energy has a direct impact on rumen ammonia levels, directing it towards either microbial protein production or free ammonia which is absorbed across the rumen wall and into the bloodstream.

Consider this : If the rumen degradable carbohydrate and fibre levels in the ration are very low, even diets that are low in protein could still result in high MUNs.

The total NFC and degradable fibre levels should be considered in evaluating the nutrition program of herds with high MUNs. Ensure that the producer is feeding appropriate amounts of NFC in the ration (normal levels should be between 36 and 42, depending on the ration ingredients). The relative rates of rumen degradability of the ration protein and energy sources can also influence ammonia levels in the rumen. For example, a good quality legume haylage is more rapidly degraded in the rumen than a lower quality dry hay. If a producer is feeding dry whole corn (slower degradability) with a good quality haylage (rapid degradability), consider rolling the corn finer to increase the rate of rumen degradation or add some barley to the grain mix, making the rumen energy portion of the diet more rapidly degraded to match the protein source. Routine MUN testing can potentially be used as an indicator if a new ration has been adequately balanced in terms of protein and energy degradabilities with a new forage changes or changes in ingredient processing.

- 3) Normal Levels - Ontario DHI representatives have published guidelines for MUNs and state that “ideal” levels for dairy cows should be between 10 and 14. There are several reasons why this range is unrealistic and subject to interpretation.

??Timing of sampling - As mentioned previously, the time of sampling relative to feeding, especially in AM / PM herd sample programs or herds milking 3X can lead to different “normal” values.

??Accuracy of the test - Because the MUN test is a NIR technology, it must be calibrated against a standard test to ensure that it is accurate. Recent work by Elliot Block and Daniel Lefebvre (McGill University) found that when individual cow results were compared against a more accurate test, the NIR test varied by +/- 3 units. This means that a cow that has a MUN test of 18 could range between 15 and 21! This variability shows why individual cow tests are very unreliable as a basis for interpretation of MUN results. When cows are grouped this variability becomes less of a factor because the individual variation cancel each other out. As a result, **only herd average values should be used to interpret MUN values and for evaluating a herd’s nutrition program.**

??Field values - The range of 10 - 14 was established from laboratory settings where cows are kept under constant conditions and fed ideal rations. It is true that physiologically, a cow with a MUN test of 10 to 14 is ideal, but this number is subject to genetic variation, ration ingredients, production level, and herd management. With the normal variation in nutrition and management seen on all dairy operations in Ontario, it is unrealistic to assume that all dairy cows live in lab conditions at a fixed rate of feeding etc... As a result, we feel that a more realistic normal range is 10 - 16 for herds that feed a TMR or component fed herds that have good management and feeding practices. In herds which do not closely follow a structured feeding program, or are unable to easily alter

grain processing methods or feed delivery system, a more appropriate range would be 12 - 19. **In our opinion dairy herds should have their nutrition program evaluated if 2 consecutive tests reveal values that exceed these ranges, either above or below.**

If herd MUN averages are > 16 for 2 consecutive tests, the following factors should be considered :

- Is the herd on AM / PM testing schedule ? Time of sampling could affect results.
- Was consistent ration being fed at test ? Interrupted feedings and varied ration ingredients can alter rumen bacteria populations potentially leading to altered MUN values.
- Which group of cows are affected ? Is there a specific ration that appears to be responsible ?
- Are certain cows artificially raising group average ? There is a significant individual and test variation that should be considered when extreme values impact group averages.
- Have forages been tested lately ? A change in forage quality not accounted for in the ration could lead to altered rumen fermentation and MUN values.
- What is the ration NFC / DIP ratio ? Ideal ratios are 3.4 to 3.7 : 1 for corn based diets and 3.0 to 3.2 : 1 for barley based diets.
- Is the degradability of both protein and carbohydrate sources similar? Consider altering the processing of energy sources to make them more rapidly available to match protein sources or substituting a more rapidly degradable source of carbohydrate into the diet to increase rumen efficiency.

If herd MUN averages are < 10 for 2 consecutive, the following factors should be considered :

- Consider all of above factors in interpreting results
- What are herd dry matter intakes ? Lower DMI can lead to lower MUNs due to lower rumen efficiency
- Is there evidence of rumen acidosis or shortage of rumen available protein in the diet? Very poor quality hays or heated silages could lower the DIP fraction of the diet.

Presently the link between herds with high MUN tests and poor reproductive performance appears to be very unreliable and highly inconsistent. There are trials, along with several experiences in the field where reproductive performance has improved when MUN levels exceed 18. As a result, more research is required before making these statements reliably.

MUN testing is an additional source of farm information that can assist in making nutrition management changes within a dairy herd. It is important to understand the

basis of MUN tests and their limitations prior to making any nutritional or management changes. MUNs are part of a dairy herd monitoring system which when implemented can optimize cow performance and profitability.

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