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MILK UREA NITROGEN TEST (MUN)

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WHAT IS MILK UREA?

Protein eaten by the cow is classified into two components, rumen degradable protein (RDP) or rumen undegradable protein (RUP). Rumen undegradable protein is sometimes referred to as rumen by-pass protein because it resists breakdown in the rumen and is broken down in the small intestine. Protein degraded in the rumen is used by the rumen microbes to make microbial protein, which in turn is used by the cow to make milk. In order for the rumen microbes to make protein they need a source of soluble carbohydrate and soluble (RDP) protein, primarily in the form of ammonia. Excess ammonia in the rumen moves through the rumen wall into the blood stream. Ammonia is very toxic to most mammals and needs to be removed from the body. Blood ammonia is converted to non-toxic urea in the liver. Urea is a small, water-soluble compound that equilibrates throughout all parts of the body and is found in the blood, milk, and urine. Urine is the primary route for excretion from the body as a waste product. Conversion of ammonia to urea in the liver requires a substantial amount of energy that could be used to make milk.

WHY USE MILK UREA FOR A TEST METHOD?

There is a high correlation between blood levels of urea and milk, but milk is preferred because it is non-invasive, easy to collect, less variable during the day (average of day), and is a practical method of sampling compared with blood. The test requires no special on-farm equipment and can be analyzed using the same milk sample taken during a regular DHIA test. All you have to do is have your DHIA technician make a note on the barn sheet that you want the test run.

WHAT ARE RECOMMENDED CONCENTRATIONS?

Concentrations for MUN in the United States are expressed as mg/dl (100 ml = 1 dl or deciliter). We recommend 12 - 16 mg/dl. Northeast and Pennsylvania DHIA recommend either 12 - 16 mg/dl (Northeast) or 10 - 14 mg/dl (Pennsylvania) as recommended concentrations.

WHAT DOES MUN TELL YOU?

If MUN concentrations are outside of the recommended levels, it signifies that there is an imbalance between the rumen soluble carbohydrates and protein needed for microbial synthesis. If the MUN concentration is low there is probably either too little soluble protein in the ration or an excess of soluble carbohydrate. Conversely, a high MUN concentration means there is too

much soluble protein or too little soluble carbohydrates. Excessive RUP or protein in general can also result in high MUN concentrations. Dairy farmers and nutritional consultants have used MUN concentrations to determine if:

- their ration is properly balanced,
- if the ration on paper or mixed is the same as what the cows are eating,
- if the values used by the computer are the same as the ingredients that went into the ration (i.e., if you change bags of haylage, is the protein % the same as before),
- if there are undetected equipment problems that changed the ration.

While most DHIA production variables such as fat %, protein %, and somatic cell count are fairly straight-forward and the interpretation relatively unambiguous, MUN values require caution in interpretation and it is strongly advised that a dairy producer consult with a competent nutritionist before making any major changes in a ration based on MUN concentrations. Ration changes should be made slowly and in small increments.

How Good Is the Test?

The answer to that question depends on the type of machine being used to analyze for MUN. There are two types of machines, infrared (IR) and wet chemistry. The IR machine is the same one that is used by DHIA to determine the levels of protein %, fat %, and somatic cell count. MUN is determined by using a different wave length of light than the other milk components. This test is quick and easy to run, but the wavelength of light used picks up other nitrogen compounds in milk. This will result in greater variability between cows depending on the level of these other nitrogenous compounds. Research has shown that IR can underestimate high and overestimate low MUN.

The wet chemistry method is superior to the IR (primarily the Foss 4000) in the accuracy of the analysis because all it measures is urea - nothing else. The main problem is this analysis is much slower and requires a separate piece of equipment. The wet chemistry method is the method of choice based on accuracy. Rocky Mountain DHIA uses the wet chemistry method.

Is There a Difference Between Holsteins and Jerseys?

Research from Pennsylvania suggests that the average MUN for Jerseys is about 2-3 mg/dl higher than Holsteins. Work at USU, using DHIA records, showed that Holsteins averaged 15.2 mg/dl while Jerseys averaged 13.7 mg/dl. Research has shown that MUN concentration is a function of body weight with larger breeds having a higher MUN.

How Is MUN Related to Milk Yield, Protein % or Fat%?

Work at USU suggests that MUN levels change similar to milk yield - lower during the first 30 days in milk (DIM), then increases and peaks at approximately 60 - 70 DIM, then decreases. We suggest that changes in ration composition was the driving factor in MUN changes. MUN was related to protein % in Holsteins with lower (within normal ranges) MUN concentrations associated with higher milk protein %. This relationship was not seen in Jerseys. Milk fat% was not related to MUN within normal fat % levels.

Relationship Between MUN and Reproduction

There is a great deal of controversy regarding the relationship between high urea levels and reproduction. There are many controlled studies that show a clear relationship between high levels of MUN and impaired reproduction. Other studies show no relationship, particularly in those studies using averaged DHIA records from several commercial dairies. While there are physiological reasons for impaired reproduction, such as early embryonic deaths and changes in

the uterine environment, the lack of response to groups of commercial dairies may be due to variations in management that are hidden due to averaging. Current research suggest that excessive body weight loss, enhanced by high MUN, may be a critical factor. As noted earlier, high blood ammonia requires energy to be converted into urea in the liver. This energy diversion, especially during the negative energy balance found in early lactation, can lead to excess weight loss. Excessive body weight loss is most often associated with reproductive problems. If a manager is able to minimize weight loss, even with high MUN, then reproductive problems may be minimized or not develop. Body condition scoring and MUN concentrations can be useful tools for troubleshooting and eliminating possible reproductive problems on a dairy.

OTHER COMMENTS:

1. Variations between cows within a herd can be large, so results from individual animals are not representative of herd MUN concentrations and should not be used. Always sample a minimum of at least 7 - 8 cows per group or time period. It is easier to sample the whole herd and this is recommended because the cost per cow is cheap ($0.10 per cow, RMDHIA) and ease of handling in the lab. Variations between animals are due to time since last feeding, time of day of sampling, the ration fed, what ration was actually eaten by the cow (selective eating of concentrates compared with forage), water intake, etc. It is very important to never make a management decision for the herd or even an individual cow based on the results of a single sample from one animal. Others have recommended that a baseline period of 6 - 8 months be used to determine your herd concentrations.
2. Bulk tank samples are interesting and useful for getting a general picture of how the herd, as a whole, is doing; however, it does not supply enough management information such as which string(s) are high or low, or if a certain stage of lactation is out-of-line. These can all be masked by a bulk tank sample and won't tell you where to look for a ration or group problem. Averaging of individual cows or groups of cows is recommended.

The MUN test can be a valuable tool, when used with other management tools, to determine how well the cows in your herd are responding to a given ration. The use of this test can help determine if you are feeding excess protein (a costly problem), or if adding a little more soluble concentrate to the ration can give an increase in milk production. Small changes in the cost of a ration can make a big difference in your cash flow. For more information, contact your county extension agent, Rocky Mountain DHIA or your DHIA Technician.

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