INTERPRETATION OF MILK UREA NITROGEN VALUES

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Milk Urea Nitrogen (MUN)

Urea is produced in the liver from ammonia derived mainly from the breakdown of protein in the rumen and from normal daily metabolism of absorbed amino acids and body protein. If bacteria in the rumen cannot capture the ammonia and convert it to microbial protein, the excess ammonia is absorbed across the rumen wall. Excess ammonia circulating in blood can be toxic and the conversion of blood ammonia to urea is the way to prevent this toxicity. The body excretes blood urea in urine and milk. Urea nitrogen (N) levels in blood plasma, blood serum and milk of an individual cow are highly related. Therefore, MUN values are representative of urea levels of blood and other body fluids. Because MUN is a breakdown product of protein, it can be used to monitor protein status of cows. In addition, MUN values can be used to improve the efficiency of microbial protein synthesis, which may reduce N excretion into the environment.

Normal ranges for MUN

There are various ranges reported for MUN, which can make interpretation challenging, Table 1. Some researchers recommend a range of 10 to 14 milligrams per deciliter (mg/dl) while others recommend at range of 8 to 12 mg/dl. The later range reflects rations that are formulated to the cow's requirement for protein and excel in the balance of protein, protein fractions, and carbohydrates to capture excess ruminal ammonia. These values typically are associated with a ration protein level of approximately 16%. Researchers from the University of Wisconsin estimate that there is 2 mg/dl change for each one percentage unit change in protein when rations contain 15 to 18.5% protein. Herds with an MUN above 12-14 mg/dl would have increased urinary N excretion and there would be opportunities for improvements.

There are many factors affecting MUN values. The feeding system, i.e. total mixed rations (TMR) versus component-fed herds, and cow eating patterns can affect MUNs. The time of feeding relative to milking time; MUN values usually peak 3-5 hours after feeding. In addition, herds milked 3x tend to have higher MUN values than herds milked 2x. The AM MUN value is usually lower than PM samples taken from the same herd. When comparing MUN values in a herd between months, account for differences in sampling times. Another factor affecting MUN values is breed. Holsteins usually have a lower MUN value than other dairy breeds, e.g. Jerseys. However, this may be due to body weight rather than a breed difference. Also, MUN values tend to be higher in the summer months.

One strategy for a meaningful interpretation of MUNs on a particular dairy operation is to evaluate the current ration along with either DHIA's MUNs and/or bulk tank values. It is helpful to have several MUN values to compare on a particular diet as a baseline. This will help determine possible problems in the ration or feed management practices. Two possible problem areas would be MUNs that are high (>12-14 mg/dl) and that are very inconsistent. When the herd MUN changes by more than 2 to 3 points (normal variation), investigate ration or forage changes and feed management problems (e.g. sorting). As milk

plants include MUNs in their testing programs, there is an opportunity to examine weekly averages as large variations occur day to day. Also, DHIA and milk plant MUN values can vary due to differences in machine standards and sampling. The advantage of DHIA MUNs is that individual cow and group problems can be identified whereas bulk tank MUNs can evaluate the whole herd on a more frequent basis.

When it is determined that MUN levels are outside normal ranges, investigate the ration, milk components, feeding management and nutrient balance. Low MUNs (<8-10 mg/dl) indicate a possible dietary protein deficiency, which can result when the rumen bacteria yield is reduced, thereby limiting milk production and milk protein yield. High MUN levels (>12-14 mg/dl) can be associated with excess dietary protein or an imbalance of ruminal protein, protein fractions and energy (non-structural carbohydrates). These factors can also be related to reduced milk yield, true protein, and feed efficiency. High MUN values indicate wasted feed protein and more energy being used by the cow to excrete that extra protein. It also means that excess nitrogen is being excreted into the environment.

Reasons for MUN levels falling outside recommended ranges

Milk and blood urea N have been related to efficiency of N use. As excessive protein or rumen degradable protein is consumed, MUN may increase. A positive relationship has been found between MUN and urinary N excretion so that monitoring MUN can help reduce excessive N excretion. The key factor is providing adequate rumen available carbohydrates to provide the energy for the rumen microbes to convert ammonia into microbial protein.

Some feed and management changes that may lead to higher MUN values:

1. Feeding new crop corn silage that may not have the same level of fermentable carbohydrate (less starch or starch is less available) compared to corn silage that has fermented for a period of time.
2. Cows grazing lush pasture can increase their intake of total and degradable protein.
3. Change to a different hay-crop silage that is wetter or higher in protein and/or soluble protein.
4. Feeding corn grain that has a coarse particle size. This may reduce the rate of fermentation in the rumen and may not match with the protein fractions being fed.
5. Shifting from processed corn silage to unprocessed or improperly processed corn silage. This could affect the amount of available fermentable starch.
6. Incorporating more degradable protein sources (e.g. changing from heat-treated soybeans (whole or cracked) to raw soybeans or heat-treated beans that are ground), which results in more rumen ammonia.

If the rumen does not maintain a minimum level of ammonia, milk yield and milk protein yield may drop because of reduced microbial protein synthesis. If MUNs are low (<8-10 mg/dl), evaluate the protein level, protein sources and protein fractions being fed. A nutritionist should be consulted when MUNs are outside the normal range. Discuss with your nutritionist better ways to balance both protein and carbohydrate fractions in the diet to improve rumen fermentation and nutrient balance.

Table 1. Guideline for interpreting whole herd MUN values (bulk tank milk).

MUN	Comment*	Suggestions*
<8 mg/dl	Low	Consider MUN as too low if production is less than 70 lbs. and the herd rations are not formulated for low protein (i.e. 16%). For TMR-fed herds, send out an analysis to confirm protein level. For component-fed herds and TMR-fed herds, use DHIA to evaluate individual cows and groups of cows. Evaluate protein and carbohydrate sources.
	Okay	If production is greater than 70 lbs, and the ration is formulated for low protein and well balanced for protein and carbohydrates, then the MUN may be okay.
8-10 mg/dl	Slightly low	If the ration is not formulated for low protein and milk production is less than 70 lbs, then there may be some feed management problems and/or ration program issues to address.
	Okay	If production is greater than 70 lbs, and the ration is formulated for low protein and well balanced for protein and carbohydrates, then the MUN may be okay.
12-14 mg/dl	Slightly high	If the ration is formulated for low protein and there are no feed management issues, then closely evaluate the protein fractions (especially soluble protein) and the level and sources of non-structural carbohydrates.
	Okay	If the ration is formulated for high levels of protein (>17.0%) and there is only one cereal grain source being fed, then the MUN level may be okay. However, there may be opportunities to lower the protein level to reduce N excretion.
>14 mg/dl	High	For TMR-fed herds, send out for analysis to confirm protein level. For component-fed herds and TMR-fed herds, use DHIA to evaluate individual cows and groups of cows. Evaluate protein and carbohydrate sources. Evaluate feed management practices, e.g. sorting.
	Not recommended	If the ration is formulated for high levels of protein (>17.0%), high levels of degradable protein and/or inadequate starch or sugar sources, then N is not being efficiently used by the animal and excessive levels of N are being excreted.

*Comments and suggestions are based on field observations and do not address every possible explanation for the MUN level being observed.