MUN as a Management Tool

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TAKE HOME MESSAGE

- Milk urea nitrogen (MUN) allows the dairy farmer and nutritionist to evaluate how dietary protein is being utilized including form of protein, level of rumen fermentable carbohydrate, and rumen efficiency.
- MUN values should range from 11 to 18 for the herd. High producing and open cows can be evaluated to determine if dietary protein is optimum and if fertility can be reduced.

Dietary protein continues to be a "hot" topic on the dairy farm. Protein is an expensive nutrient ($0.22 per pound of crude protein based on soybean meal at $185 per ton), several forms of protein are balanced in the field which are difficult to measure (UIP, DIP, and SIP), and amino acid balancing is here. Dietary protein levels are increasing for several factors.

1. Milk yield per cow continues to increase 2 to 3 percent annually (one pound of crude protein is needed for every 10 pounds of milk).
2. Emphasis on component pricing has raised interest in higher milk protein content.
3. Rations primarily based on high quality legume forages results in rations high in DIP and lower in UIP.
4. Legume-grass forages vary due to growing and harvesting conditions resulting in a protein safety factor (one percent crude protein point above recommended ration protein (18.5 when 17.5 percent protein is adequate).
5. With lower dry matter intake in early lactation, higher levels of protein are fed to deliver needed amino acids.
6. If added fats are included in the ration, more UIP may be needed if fermentable energy decreases because less microbial protein is synthesized.
7. Cows mobilize body fat in early lactation as an energy source while protein tissue mobilization is more limited.

Higher levels of dietary protein cause problems health, production, or reproduction problems. Measuring MUN can be a useful management tool to evaluate protein status and minimize these potential negative effects. Milk urea nitrogen (MUN) tests are available through DHI and private labs.

MUN is the portion of nitrogen in milk in the form of urea (compared to casein and whey proteins). As the level of blood urea nitrogen (BUN) increases, the level of milk also increases lagging blood level by 2 hours. Thus, MUN reflects BUN over 12 hours that milk was produced (8 hours if cows are milked 3X). MUN has been found to be 83 to 98 percent of the BUN concentration. Cornell workers suggest dividing MUN by 0.85 to estimate BUN.

If ammonia is not utilized by rumen microbes (converted to microbial protein), it is absorbed across the rumen wall and into the blood. Blood ammonia can shift blood pH and be toxic to the animal. The liver converts ammonia to urea, releasing in the blood as BUN, and excreting it in urine (major route), milk (as MUN), and uterine fluid, or recycling to the rumen by saliva. High levels of BUN can reflect several nutritional problems.

1 Protein imbalance with high levels of total protein, excessive degradable intake protein (DIP), high or low undegradable intake protein (UIP), amino acid imbalance, and/or excess soluble intake protein (SIP).
2 A shortage of rumen fermentable carbohydrate (CHO) including starch, pectin, or sugars to capture available rumen ammonia as microbial protein.
3 Poor rumen microbial environment reducing microbial growth (low pH, no forage mat, abnormal volatile fatty acid profile, or slow rate of passage).

Low levels of BUN can reflect inadequate ammonia in the rumen for optimal microbial growth leading to protein shortage in the cow.

New York researchers suggest herd levels less than 12 and over 16 mg/100 ml can reflect losses of nutrients, higher feed costs, health effects, and reduced milk production. Individual cows MUN can vary greatly (values as low as 1 and over 30 mg/100 ml). Summarizing 10 or more MUN values is suggested (this approach may reflect MUN within 1 to 2 MUN units of the group value). A range of 12 to 18 mg/100 ml is a desirable for herds and individual cows from 8 to 25 mg/100 ml. If individual cow MUN values are under 8 mg/100 ml (herd average under 12), protein levels and rumen available CHO levels should be reviewed. Low microbial protein yield can limit protein and milk yield. Table 1 illustrates how MUN and milk protein percentage values can be used to interpret field results (raise milk protein levels to reflect cows in later stages of lactation and higher testing breeds). If individual cow MUN values are over 25 (herd average over 18), several losses can be occurring.

1. Significant energy losses occur when a cow must convert ammonia to urea and excrete it in urine. Using the Cornell model and a diet that predicts MUN over 20, seven pounds less milk would be produced as energy was diverted from milk production to urea synthesis.
2. If you are purchasing protein that is being excreted as urea, the financial loss could be $0.20 per cow per day (2 pounds of protein supplement valued at $0.15 per pounds used as an energy source compared to 2 pounds of shelled corn valued at $0.05 per pound).
3. New York and Pennsylvania workers have reported that high levels of BUN can reduce conception rate.
4. High levels of protein can affect cow health and the immune system.
5. High BUN levels have an environmental impact as excessive nitrogen is excreted in manure with odor and water quality ramifications.

The cost of measuring MUN will vary (currently the Dubuque DHI Lab is charging $0.10 per sample if all cows during the normal DHI test are tested for MUN or over $1 per sample if only select non-DHI samples are sent in). The type of report can also increase costs $0.05 per cow (more cow data). MUN can be run quarterly to establish a base line value, when a major ration change has occurred, or a protein related concern may be occurring. Consider testing MUN when this factors occurs.

1. Feeding cows lush pastureNew forages are being fed
2. Changing the levels of undegradable, degradable and/or soluble protein in the diet
3. Shifting the particle size or moisture of grain
4. A decline in conception rate has occurred
5. Low milk protein test
6. Change in fecal consistency or odor

Test the entire herd if an economical lab is available to get a MUN baseline for future comparisons and changes. Review MUN levels in the high producing, first lactation, and other groups to see if MUN patterns exist. MUN values in cows fresh less than 35 days are variable and difficult to interpret. In the first month, 10 percent of Illinois herds requested the MUN test. In the second month, the herd numbers dropped to 7 percent. Table 2 illustrated the MUN profile of Illinois herds. One concern was a significant number of low values (from 0 to 5 mg/100 ml) which are not normal. To avoid biasing herd averages, MUN cow values below 5 mg/100 ml were reported as "< 5 mg/100 ml" and not used to calculate the herd average. If cow or herd values are low, consider the following points before making major ration changes.

- Is milk protein normal? (Low MUN would predict low milk protein tests)
- Is fecal consistency consistent with low MUN values? (Low MUN would predict stiff manure)
- Is ration values consistent with low MUN? (Low MUN would predict low DIP, high or low UIP, high NDF, and/or low NFC)

TABLE 1. Interpretation of Holstein herd MUN with milk protein levels in early lactation (adapted from New York DHI).

Milk Protein	Low MUN	Optimal MUN	High MUN
%	(<12)	(12-17)	(>18)
Under 3	Protein def	Protein def	Excess Protein
	DIP/SIP def	Rumen CHO def	Excess DIP/SIP
		AA def	Def rumen CHO
			Imbalance AA
Over 3.2	Adeq AA	Balanced AA	Exceee DIP/SIP
	Def DIP/SIP	Balanced rumen CHO	Def rumen CHO
	Excess rumen CHO		

AA = amino acids, def = deficiency, adeq = adequate

TABLE 2. Field MUN results from Dubuque DHI Lab.

Number of herds tested	236
Number of cows tested	14865
Average MUN value	15.9
Herds between 11 to 20 MUN	179
Herds over 20 MUN	29
Herds over 25 MUN	3
Herds under 11 MUN	28
Herds under 9 MUN	9
Cows under 5 MUN	608
Herds with two MUN tests	59
Herds <1 change in MUN	17
Herds 1-3 change in MUN	28
Herds 3-5 change in MUN	4
Herds >5 change in MUN	10