Use of Milk Urea Nitrogen in Herd Management

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Abstract

Milk urea nitrogen **(MUN)** has been proposed as a management tool for nutritionists and dairy farmers to use as a monitor for protein feeding rates and nitrogen metabolism in lactating dairy cows. Dietary crude protein **(CP)** content has the greatest nutritional influence on MUN concentrations and has the potential to be used as a management tool for assessing dietary protein feeding. The MUN concentrations are also influenced by a number of other nutritional, cow, and environmental factors. Several statistical analyses of DHI data bases report mean MUN concentrations for Holstein cows ranged between 12.7 to 15.5 mg/dL and 14.1 to 14.4 mg/dL for Jersey cows. A number of milk marketing organizations test every farm's bulk milk samples for MUN, and DHI organizations can test individual cow milk samples for MUN. Before reformulating a diet, the nutritionist and herd manager should investigate and consider all possible reasons why MUN concentrations are above or below what they regard as desirable for the herd or cow group. Basing diet reformulation solely on bulk tank or individual cow MUN concentrations may be too hasty and unwise. The purpose of this paper is to discuss the role that monitoring MUN can have on herd management.

Background

Much of the CP a cow consumes is degraded by rumen microbes to ammonia and used for the synthesis of microbial cell protein. Ammonia is also produced from normal daily metabolism of absorbed amino acids and body proteins. Excess rumen ammonia is absorbed from the rumen, and ammonia from tissue metabolism is transported in blood to the liver and kidneys where it is converted to urea. Some of the urea circulating in blood recycles in the saliva back into the rumen. Excess ammonia circulating in blood is very toxic, whereas urea is much less so. The conversion of blood ammonia to urea occurs in mammals, including humans, and is part of normal body metabolism as a way to prevent ammonia toxicity. Urea is a normal constituent of blood and body fluids and readily diffuses in the blood and body fluids.

Urea is also a normal constituent of milk and is part of the non-protein nitrogen fraction of milk. Concentrations of urea circulating in blood, defined as blood urea nitrogen **(BUN),** are highly correlated to the concentration of urea in milk (Broderick and Clayton, 1997).

Dietary CP content has the greatest nutritional influence on BUN and MUN concentrations, and they have the potential be used as a tool for assessing protein feeding (Broderick and Clayton, 1997; Jonker et al., 1998; Nousiainen et al., 2004; Wattiaux and Karg, 2004a). There is also a positive relationship of BUN and MUN to urinary nitrogen excretion (Ciszuk and Gebregziabher, 1994; Jonker et al., 1998; Kauffman and St-Pierre, 2001; Kohn et al., 2002; Wattiaux and Karg, 2004b).

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For evaluating dietary protein levels, BUN concentrations can be measured, but measuring BUN is an invasive, time consuming procedure requiring the obtaining of blood samples from individual cows. However, obtaining milk samples to determine MUN concentrations is a much easier and non-invasive way for evaluating CP feeding levels. Therefore, monitoring MUN concentrations either from individual cows or the bulk tank has the potential of being a management tool for evaluating dietary protein levels.

Nutritional Factors Influencing MUN Concentrations

Although dietary CP level is the major nutritional influence on MUN concentrations, other nutritional factors do play a role. In a statistical evaluation of animal and nutritional factors influencing MUN concentrations, Broderick and Clayton (1997) reported a positive relationship between MUN and BUN, body weight, fat-corrected milk yield **(FCM)**, dietary CP content, dry matter intake, and days in milk. They reported a negative relationship of MUN with parity, milk and fat yield, dietary CP per unit of NE_L concentration and NE_L intake. Others have also reported similar and additional nutritional-measure relationships with MUN concentrations (Linn and Garcia, 1998; Godden et al., 2001; Nousiainen et al., 2004; Wattiaux and Karg, 2004a).

Cow and Environmental Factors Influencing MUN Concentrations

Breed effects on MUN concentrations are variable and may need to be considered when evaluating MUN in herds with mixed breeds. In a study using data from milk testing organizations, Brown Swiss and Jersey had higher test-day MUN concentrations compared with Holstein cows (Wattiaux et al., 2005). However, when the same diet was fed, MUN was greater in Holstein cows as compared to Jersey cows (Rodriguez et al., 1997; Rastani et al., 2001), but it was the same for both breeds in another study (Kauffman and St Pierre, 2001).

Parity appears to have little effect on MUN concentrations (Broderick and Clayton, 1997; Ferguson et al., 1997). Time of day when a milk sample was obtained influenced MUN concentrations with AM collected milk having higher MUN concentrations than PM milk (Broderick and Clayton, 1997; Godden et al., 2001; Wattiaux et al., 2005). Also, Gustafsson and Palmquist (1993) reported that MUN concentrations were the highest at about 4 hours after feeding. Higher yields of milk and FCM have been associated with higher MUN concentrations (Linn and Garcia, 1998; Broderick and Clayton, 1997). In early lactation, MUN concentrations have been reported to be higher than in the later stages of lactation in studies using data from milk testing organizations (Johnson and Young, 2003; Rajala-Schultz and Saville, 2003; Wattiaux et al., 2005). Care should be taken when evaluating diet protein feeding levels based on MUN concentrations of cows in early lactation because tissue protein metabolism for energy can influence MUN concentrations (Wattiaux et al., 2005). Season of the year variations in MUN have been reported using data from milk testing organizations, and the researchers suggest that a combination of seasonal factors, such as temperature, humidity, feeding programs (grazing), and calving patterns, in combination make it difficult to pinpoint seasonal effects (Ferguson et al., 1997; Godden et al., 2001; Wattiaux et al., 2005).

What are Normal or Suggested MUN Concentrations

The first question most people ask is, "What are normal or the recommended MUN concentrations?" That is a difficult question to answer.

Mean MUN concentrations have been reported for statistical evaluation of DHI data bases. Wattiaux et al. (2005) in their evaluation of Midwest dairy herds using DHI records observed that mean MUN concentration was 12.7, 14.6, and 14.4 mg/dL for Holstein, Brown Swiss, and Jersey cows, respectively. Johnson and Young (2003), using DHI records of western herds, reported mean MUN concentration of 15.5 and 14.1 mg/dL for Holstein and Jersey cows, respectively. While mean MUN concentrations are interesting, they do not provide what the recommended MUN concentration should be. Kohn (2007) suggested that under typical production conditions, herd MUN concentrations should be between 8 to12 mg/dL, based on a field study of herds in Maryland and Virginia (Jonker et al., 2002). Dickrell (2007) referenced research by Broderick (USDA Forage Laboratory, Madison, WI) who suggested MUN concentrations of 10 to 12 mg/dL for Holstein cows and 12 mg/dL for Jersey cows.

Using MUN in Herd Management

Dietary CP levels are the main nutritional influence on MUN concentrations. Nutritionists and dairy farmers would like to know if the diets formulated and fed are resulting in efficient protein utilization or is there a need to reformulate the diets.

A number of the milk marketing organizations test milk bulk tank samples for MUN concentrations. Bulk tank milk is picked up every day or every other day on most dairy farms, and this allows for very frequent monitoring of MUN. However, the bulk tank sample represents milk for all cows whose milk was put into the tank. Thus, the bulk tank sample does not allow for the monitoring of MUN from different cow groups, which may be fed different rations and concentrations of protein levels.

Suggestions for Using Bulk Tank MUN

Monitor bulk tank MUN to establish a herd baseline over a 3 to 6 month period. Day-to-day bulk tank MUN concentrations will vary considerably. If after establishing a herd's baseline and the MUN concentrations remain for a week or two above or below the suggested ranges of 10 to 12 mg/dL for Holstein cows or 12 mg/dL for Jersey cows, then the possible factors influencing MUN concentrations should be evaluated. However, variations in bulk tank MUN concentrations are too great to make sound, informed decisions for diet formulations based only on these data. So, this may be the time to collect MUN data for individual cows to pinpoint which cows or feeding groups are the contributors to the high or low MUN concentrations in the bulk tank. Another, possible option would be for a farm to use an "inline milk sample collector" that obtains a milk sample as it goes from the parlor to the bulk tank. These devices are commercially available. This would enable the obtaining of a milk sample from a specific group or pen of cows. The resulting sample would represent all the milk from all cows within a group or pen. This would allow for determining MUN concentrations and other milk components for a specific cow management group instead of obtaining milk samples from individual cows.

Suggestions for Using Individual Cow MUN

Many DHI organizations test milk samples for MUN concentrations from members and also non-members. A nutritionist, along with a herd manager, can decide which cows or groups would be the best candidates from which to obtain milk samples. They would need to decide on the number of cows to sample to obtain a representative MUN concentration for the cows within a group or pen.

Remember that time of day when a milk sample is obtained influences MUN concentrations. Milk samples for MUN should be obtained at the

same milking time when colleting individual cow milk samples on different days. For many herds on DHI, test-day milk samples are collected from only one milking and are often taken at the AM milking one month and then at the PM milking the next month. For 3X milked herds, this variation in the time of day the milk samples was obtained will be greater. This needs to be considered; otherwise, accurate and reliable MUN results will not be obtained to make informed decisions for diet formulations.

In addition, proposing to reformulate a diet based solely on bulk tank or individual cow MUN concentrations would be unwarranted and unwise. Before reformulating a diet, a nutritionist and herd manager should investigate and consider all the possible reasons why MUN concentrations are above or below what they regard as desirable for the herd or group.

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