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Sampling techniques for and interpretation of milk urea nitrogen concentration

Abstract

Representative MUN values can be obtained by testing a milk sample before milking, at AM or PM milking, or with an in-line siphon sampling device. MUN values obtained from homogenous milking strings are as accurate as an average MUN value obtained by sampling each cow in the string. Bulk tank sampling is not advisable because of the variation in MUN caused by stage of lactation. Small herds that feed a single TMR should use the average MUN from cows between 60 and 200 days in milk. Monthly sampling is recommended to build a database. The effect of diet changes on MUN can be assessed within 7 days.; Dairy Day, 1998, Kansas State University, Manhattan, KS, 1998;

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SAMPLING TECHNIQUES FOR AND INTERPRETATION OF MILK UREA NITROGEN CONCENTRATION

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Summary

Representative MUN values can be obtained by testing a milk sample before milking, at AM or PM milking, or with an in-line siphon sampling device. MUN values obtained from homogenous milking strings are as accurate as an average MUN value obtained by sampling each cow in the string. Bulk tank sampling is not advisable because of the variation in MUN caused by stage of lactation. Small herds that feed a single TMR should use the average MUN from cows between 60 and 200 days in milk. Monthly sampling is recommended to build a database. The effect of diet changes on MUN can be assessed within 7 days.

(Key Words: Milk Sampling, Milk Urea Nitrogen, Blood Urea Nitrogen.)

Introduction

Milk urea nitrogen (MUN) is a reasonable estimate of blood urea nitrogen (BUN), which, in turn, is a reasonable predictor of the protein status of the dairy cow when used in conjunction with other herd information such as diet, age of the cow, sampling time after feeding, days in milk, stress due to weather, exercise or health status, and method of sampling. Blood urea nitrogen is a by-product of ammonia clearance from the blood in order to maintain blood pH at 7.0. This detoxification event occurs in the liver where two amine groups (NH_2) are bonded to a ketone (C=O) to form urea for excretion primarily in the urine or to be recycled back into the rumen via the salivary glands to serve as a nitrogen source for rumen microorganisms. The urea nitrogen in milk is in equilibrium with that in the blood; thus, milk samples provide a convenient method of determining BUN.

The origin of BUN is primarily ammonia absorbed from the rumen with lesser amounts from protein (or amino acid) metabolism to provide glucose or energy during periods of negative energy balance. The latter source is relatively minor when compared to the ruminal contribution. Therefore, BUN levels provide a reasonably accurate reflection of dietary effects on rumen function. Our work clearly demonstrates that BUN is strongly influenced by feed intake. Figure 1 depicts the changes in blood serum concentrations of urea nitrogen during advancing days in milk and also demonstrates that sampling only a few cows in the herd, without regard to stage of lactation, could provide misleading information.

The purpose of our study was to assess various sampling techniques in order to provide dairy producers with the most convenient method of obtaining MUN values that accurately reflect management changes in the herd.

Procedures

Cows at the Kansas State University Dairy Teaching and Research Center were used to evaluate various milk sampling techniques for MUN analysis. The MUN analyses of all milk samples were conducted at the Heart of America DHIA Laboratory located in Manhattan, KS. Data were collected to determine: 1) if a single quarter sample of milk obtained immediately after prepping and before attaching the milking unit provides an accurate MUN value; 2) if the MUN concentrations in AM and PM samples agree with each other and with an AM/PM composite sample; and 3) if a single string sample accurately reflects the average MUN values of the individual cows within the string. Other data also were collected to illustrate effects of the relationship between days in milk and diet changes on MUN values.

Results and Discussion

All dairy producers do not have access to devices that permit them to obtain a homogenous milk sample from each cow nor are they members of a DHIA program. Thus, if MUN levels are to be used as a management tool, it is imperative that a low-cost sampling technique be available to all producers. Further, many DHIA members use the AM/PM program that provides a homogenous sample of either AM milk or PM milk but not a composite sample of both. This study was designed to provide information on various sampling techniques and determine their accuracy relative to composite AM/PM samples.

Milk samples obtained from 104 cows (Table 1) indicate that either AM or PM samples provide a reasonable estimate of an AM/PM composite sample and were within 1 mg/dl of each other. The difference in the two values is not large enough to impact the on-farm decision-making process. Producers that do not participate in DHIA and do not have homogenous sampling devices can utilize a sample of milk from one quarter to evaluate the MUN level in their herd. Table 2 depicts the relationship among quarter samples taken immediately before the milking unit was attached and composite samples obtained after the cow was milked. Samples among quarters contained essentially the same MUN and were within 1 mg/dL of the composite sample. Again, this is well within the tolerance necessary to support management decisions.

Herd managers that group their cows by production or stage of lactation need to know the average MUN level of the group in order to facilitate decisions relative to diet components. An in-line sampling device that continuously siphons a small amount of milk throughout the milking process is being marketed (Heart of America DHIA, Manhattan, KS) as a means of obtaining a representative string sample without having to sample each cow in the string. The value of such a technique is obvious, because it would reduce sampling time and analytical cost. Cows at the Kansas State University dairy were divided into seven strings. One string contained 27 cows, and the other 6 strings contained 24 cows each (Table 3). Individual cows were sampled, and the average MUN values within a string were compared to the appropriate string composite sample. The variation between the two values was less than 1 mg/dL. Therefore, a single string sample provides a reasonable estimate to use in making decisions relative to dietary changes. We should note that this technique should be used only for reasonably homogenous groups. Bulk tank samples for an entire herd will not provide an accurate value because of the variation in feed intake across days in milk as indicated by the variation in MUN values in Table 4. Cows less that 60 days in milk generally have a lower MUN value than cows over 60 days in milk because they eat less. MUN levels tend to decline after 200 days in milk because of a decline in feed intake.

Sampling small herds that feed a single total mixed ration can be accomplished in one of two ways. All cows in the herd can be sampled and sorted by days in milk to provide a herd profile, or cows between 60 and 200 days in milk can be sampled and the average MUN value used to make decisions relative to dietary adjustments. When the entire herd is sampled, the MUN value for cows between 100 and 199 days in milk would be the most appropriate one to use, if at least 25% of the herd falls in this group. If not, then the average value should be used for cows in the 41 to 99 and 100 to 199 days in milk groups.

The impact of diet on MUN is related primarily to the contents of ruminally available protein and carbohydrates and feed intake. Changes in dietary ingredients that result in an increase or decrease in ruminally available protein and carbohydrates usually increase or decrease MUN, if feed intake remains relatively constant. Effective management of MUN levels in the herd requires a knowledge of feedstuffs with respect to their content of ruminally available protein and carbohydrate because of the variation in rumen-undegraded protein and nonstructural carbohydrates among feed grains and common by-product feedstuffs. Further, plant and(or) animal fats generally are included in diets to increase energy density; thus, they are substituted for carbohydrate. This substitution reduces the amount of energy available to rumen microbes and usually results in an increase in MUN. This is particularly true when grain sorghum is the primary grain source, because it is inherently low in rumen soluble carbohydrates. We observed positive effects on milk yield and milk protein and negative effects on MUN when wheat was substituted for 30% of the grain sorghum in diets on an equal weight basis. The positive effect of wheat was most pronounced when the diets contained approximately 5% fat. Increasing the rumen-undegraded protein from 35 to 40% of total protein by substituting expeller soybean meal for solvent soybean meal in the diet reduced our herd average MUN from 19 mg/dL to 16 mg/dL. This drop in MUN was observed within a week after the diets were changed.

These are a few examples that illustrate the effect of diet on MUN and support the potential benefit of using MUN as a management tool. Routine (monthly) MUN analysis will provide a herd baseline over time that will be useful in the decision-making process and can be supplemented with spot checks approximately 1 wk after diets are changed.

Table 1. Mun Values in AM, PM, and AM/PM Composite Milk Samples from 104 Cows[1]

Time	MUN(mg/dL)	R^2	
AM	16.26	AM to PM	.72
PM	15.18	AM to AM/PM	.89
AM/PM	15.67	PM to AM/PM	.94

[1]Cows fed between 7 and 8 AM and 1 and 2 PM. Feed available at all times.

Table 2. MUN Values in Quarter and Composite Samples from 26 Cows[1]

	Sample				
Item	LR	LF	RF	RR	Composite
MUN (mg/dL)	19.74	19.58	19.58	19.68	20.27

[1]Quarter samples taken after predipping by hand milking into a DHIA sample vial. Composite sample taken from the weigh jar after milking.

Table 3. MUN Values for Individual Cows vs. String Milk Samples

	Strings						
Item	1	2	3	4	5	6	7
No. Cows	27	24	24	24	24	24	24
Composite [1]	20.58	18.92	18.33	19.29	18.06	18.20	18.63
Individual [2]	20.17	18.13	18.00	19.27	18.16	18.37	18.94

[1] Composite sample for each string collected with an in-line sampling device.
[2] Individual samples obtained from weigh jar and represent the average of the cows in a string.

Table 4. MUN Herd Profile by Days in Milk

DIM	No. of cows	Milk, lb	Fat, %	Protein, %	MUN, mg/dL
0 - 40	14	61.3	4.60	3.20	12.7
41-99	48	93.6	3.20	2.85	16.6
100 - 199	64	80.0	3.55	3.15	16.0
200 - 299	58	70.0	3.65	3.35	15.7
300+	29	53.0	3.95	3.65	14.3
Herd Average[1]	213	75.4	3.58	3.21	15.6

[1]Weighted average based on the number of cows per group.

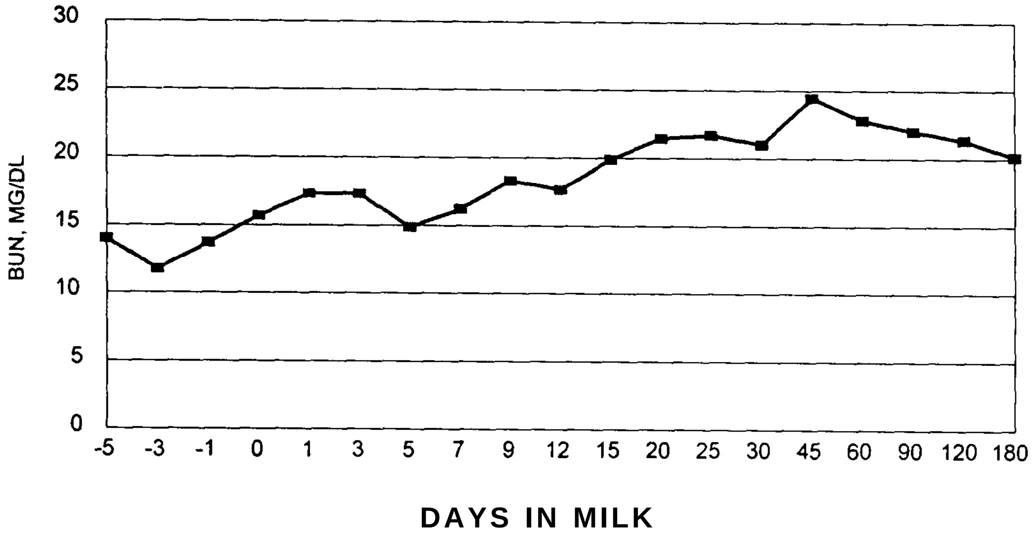

Figure 1. Relationship between Blood Urea Nitrogen and Days in Milk.