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# *Short communication:* Variability in milk urea nitrogen and dairy total mixed ration composition in the northeastern United States

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## ABSTRACT

The main objective of this survey was to examine variability in milk urea nitrogen (MUN) for Dairy Herd Improvement Association (DHIA) herds in the northeastern United States (the Northeast), examine trends in dairy cow diet composition, and determine potential relationships for MUN and diet composition. Trends in milk fat and protein concentrations, milk yield, days in milk on test day, and lactation number of the cows were also evaluated. The data set for the survey included 10,839,461 DHIA dairy cow records from 2004 to 2015 for 13 states (CT, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VA, VT, and WV) and was retrieved from Dairy Records Management Systems (Raleigh, NC). Average (across states and years) milk yield, milk fat, and milk protein were 31.6 ± 0.24 kg/d, 3.85 ± 0.021%, and 3.13 ± 0.013%, respectively. No obvious trends were observed for milk fat or protein content, but milk yield steadily increased during the survey period. Milk urea N concentration averaged 13.3 ± 0.13 mg/dL, with no obvious or consistent trends. Examination of variability in dairy feed cost and all milk price for the Northeast indicated that high MUN generally coincided with high feed cost and high milk price. For the diet composition survey, 9,707 records of total mixed ration (TMR) analyses, unrelated to the milk composition data set, from the Cumberland Valley Analytical Service (Maugansville, MD) database were examined. Concentration of TMR crude protein (CP) decreased from 17.1% in 2007 to 16.4% in 2015, but there was not an obvious trend in soluble protein concentration. Concentration of TMR neutral detergent fiber (NDF) and 24-h in vitro NDF degradability declined steadily during the survey period and was accompanied by a steady increase in TMR starch concentration. Examination of these unrelated data sets revealed lack of correlation between MUN and diet chemical composition. Thus, we conclude that individual cow MUN in Northeast dairy herds fluctuated between 2004 and 2015. It appeared that MUN followed variability in feed cost; however, ration feed ingredient data were not available to better define the reasons for the variations in MUN.
**Key words:** milk urea nitrogen, diet composition, northeastern United States, dairy cow

## Short Communication

Diet composition and nutritional strategies are powerful tools for manipulating milk composition in dairy cows. Some milk components, such as lactose, are less variable than others, such as milk fat, protein, and MUN, which are more responsive to dietary interventions (Jenkins and McGuire, 2006). Individual cow or bulk tank milk samples are regularly collected on dairy farms, and MUN is used for monitoring dietary N adequacy in dairy rations. The relationship between dietary protein intake and BUN has long been established (Lewis, 1957). In turn, a strong relationship ($R^2$ = 0.84) between BUN and MUN in dairy cows was demonstrated by Broderick and Clayton (1997). These relationships have been the basis for using MUN as a predictor of N excretion and utilization efficiency in dairy cows (Broderick and Clayton, 1997; Jonker et al., 1998; Nousiainen et al., 2004) and ammonia emissions from manure (Burgos et al., 2010; van Duinkerken et al., 2011; Powell et al., 2014). One of the most effective tools for decreasing urinary N losses and ammonia emissions from dairy manure is a reduction in dietary protein concentration (Hristov et al., 2011, 2015). Decreasing dietary protein, however, may result in loss of production or decreased milk components (Lee et al., 2012; Giallongo et al., 2016), and dairy producers and their nutritionists are cautious in implementing these

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changes. It is unclear to what extent, if any, the dairy industry in the northeastern United States (hereafter, the Northeast) is utilizing diets with decreased protein concentration. More than 70% of the commercial dairies surveyed by Jonker et al. (2002) were overfeeding protein. According to the current dairy NRC (2001) model, the MP needs of a dairy cow producing 45 kg of milk/d can be met with a balanced diet containing 16% CP, which is lower than typical CP concentrations reported for commercial dairy farms in several surveys (Hristov et al., 2006; Castillo et al., 2012; Higgs et al., 2012). In a recent on-farm project in Pennsylvania, however, we observed trends for decreased CP in lactating diets (Weeks et al., 2015), similar to those reported recently for Canadian farms by Sova et al. (2014). Therefore, we conducted a survey of DHIA records and dairy TMR samples submitted to a commercial feed analysis laboratory with the objective of investigating trends in milk components, with emphasis on MUN, in relation to TMR chemical composition for commercial dairy farms in the Northeast. Our hypothesis was that CP concentration in dairy diets has been decreasing in the Northeast and this would be reflected in decreasing MUN in milk samples from the region.

The data set for this survey included 10,839,461 DHIA dairy cow records from 2004 to 2015 for 13 states (CT, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VA, VT, and WV) and was retrieved from the Dairy Records Management Systems (Raleigh, NC). Data for lactation number, DIM on test day, milk yield (kg/d), and milk fat (%), protein (%; information on crude vs. true protein was not available), and MUN (mg/dL) contents were collected. The data set included all dairy cattle breeds. Data for states and years with too few observations were removed from the analysis; a total of 327 observations were removed. As an example, there was 1 observation for Delaware in 2013 and 6 observations in 2014; these observations were removed from the data set.

Trends in dairy diet composition in the Northeast were also examined to investigate relationships with milk components. Total mixed ration analysis data were retrieved from Cumberland Valley Analytical Services' database (**CVAS**; Maugansville, MD). Only TMR samples submitted from Northeast states between 2007 and 2015 with NDF concentration between 25 and 40% (considered a dairy TMR) were included in the survey. A total of 9,707 records were included in the data set. It is noted that the feed composition data set was unrelated to the milk composition data set. Diet composition data used in the analysis included CP, soluble protein, NDF, starch, NFC, and 24-h NDF degradability. Some analyses had fewer observations, with the fewest observations being for 24-h NDF degradability (n = 3,308). Most of the TMR analyses were by near infrared (NIR) spectroscopy versus wet chemistry (details at http://www.foragelab.com/Lab-Services/Forage-and-Feed/Lab-Procedures; accessed Feb. 19, 2017). Of the samples that entered the CVAS database, 63.5% were analyzed by NIR and 63.5% by wet chemistry. Trends in dairy feed cost (University of Wisconsin Dairy Marketing and Risk Management Program; http://future.aae.wisc.edu/data/monthly_values/by_area/2401?grid = true; accessed Feb. 20, 2017) and milk price (NASS, 2017) were also investigated. Descriptive statistics and Pearson correlation analysis of averaged by year milk and TMR composition, dairy feed cost for Pennsylvania and the United States, and Northeast milk price data were carried out using the MEANS and CORR procedures, respectively, of SAS software (version 9.4, 2002–2012; SAS Institute Inc., Cary, NC). Outliers were removed with the REG procedure of SAS based on an absolute studentized residual value >3. Dietary nutrient concentration data were fitted to a linear model using Sigma Plot 13.0 (SPSS Inc./IBM Corp., Chicago, IL).

Lactation, milk yield, and composition data are presented in Table 1. Average parity of the cows included in the survey was 2.3 ± 0.03 lactations, and average DIM on test day was 176 ± 5.8 d. Except in 2004, which was an outlier with an average DIM of 116 ± 4.0 d, the range in DIM was from 171 (2013) to 191 (2008) d. Average milk yield, milk fat, and milk protein were 31.6 ± 0.24 kg/d, 3.85 ± 0.021%, and 3.13 ± 0.013%, respectively. Milk yield for Northeast DHIA herds tended to increase slightly during the survey period, particularly between 2013 and 2015 (highest milk yield was in 2004 but this was a result of the lower DIM in that year). No obvious trends were observed in milk fat or protein content. Milk urea N concentration averaged 13.3 ± 0.13 mg/dL, with no obvious or consistent trends; MUN increased from 2004 to 2008, declined in 2009 through 2011, increased to its highest concentrations in 2012–2013, and then declined again in 2014 and 2015 (Figure 1a).

Concentration of dietary CP in Northeast TMR samples submitted to CVAS, a data set unrelated to the milk composition data set discussed above, steadily decreased (linear fit, $R^2 = 0.85$, $P < 0.001$; n = 9) from 17.1% in 2007 to 16.4% in 2015 (Table 2); TMR CP averaged 16.4 ± 0.08 in 2016 (n = 429; data not shown in table). We did not detect an obvious trend in TMR soluble protein concentration, which averaged 6.3 ± 0.09% (DM basis) for the survey period; diet RDP or RUP data were not available. Concentration of TMR NDF steadily declined (linear fit, $R^2 = 0.83$, $P$

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