**Application** Relationships between MUN and NUE within the current dataset were poor, suggesting that MUN could not be used as an ‘on-farm’ proximate measure of ‘herd’ NUE. The addition of data on dietary and cow factors might improve the prediction.

**Introduction** Improving nitrogen-use-efficiency (NUE: defined as milk N output/N intake) is key to reducing the environmental impact of dairy systems. However, while NUE can be easily measured on research farms where information on N intake is available, on commercial farms NUE must be predicted. Both blood urea N (BUN) and milk urea N (MUN) are known to be indicators of protein nutrition status in dairy cows and as such have been used as predictors of NUE. While the use of BUN requires invasive blood sampling, MUN is normally determined within routine test-day milk sampling. While previous predictions have been developed using short-term relatively homogenous datasets, this study examined relationships between MUN, BUN and NUE using a multi-experiment dataset developed over almost three decades, and which involved large variability in both diet type (all grass silage-based) and cow genotype. Relationships were examined at both an individual ‘cow’ level and ‘treatment’ level.

**Materials and Methods** This study involved a statistical re-assessment of aggregated individual cow data obtained from 39 studies conducted between 1996 and 2023 at the Agri-Food and Bioscience Institute (AFBI) in Hillsborough, Northern Ireland. Individual cow MUN data were obtained from monthly test-day milk sampling undertaken within studies (from 2008 onwards), while individual cow BUN data were obtained from occasional blood sampling undertaken within studies (according to protocols within individual experiments). Individual cow NUE was determined using daily data (N intake and milk N output) averaged for the 7-day period (day of sampling ± 3 days) around the date of blood/milk sampling. Treatment datasets were determined by averaging BUN, MUN and NUE data for all individual cows on each treatment for each week. The BUN dataset represented 1396 individual cows (704 primiparous, 983 multiparous) cows, while the MUN dataset represented 905 individual cows (408 primiparous and 662 multiparous cows). The BUN and MUN treatment mean dataset represented 116 and 56 treatments, respectively. Relationships between MUN, BUN and NUE were examined using individual cow data and treatment mean data (mean for each week) using regression analysis in Genstat v21 (VSN International Ltd).

**Results** As expected, there were positive relationships between BUN and MUN levels with both the individual cow and treatment datasets, with a 1 mg/dl increase in BUN associated with a 1.75 (individual) and 1.65 (treatment) mg/dl increase in MUN content (Table 1). With the individual cow data there were weak negative relationships for both BUN and MUN, and NUE, with adjusted R2 of 4.4 and 6.4, respectively. Similar relationships existed when treatment mean data was examined, with a 1 mg/dl increase in BUN associated with a proportional decrease of 0.009 in NUE. Similarly, a 1 mg/dl increase in MUN was associated with a proportional decrease of 0.004 in NUE. While assessing the data on a treatment mean basis did improve the adjusted R2 of all regression equations, the R2 of all relationships are low (R2 <0.5) suggesting that they could not be used to provide an accurate prediction of NUE at farm level. Given that the current dataset encompasses 39 studies conducted over almost three decades, variations in diet and cow factors over that period may have contributed to the weak relationships observed. Previous studies suggest that MUN as a biomarker of NUE is most accurate when used under similar nutritional circumstances as those under which the models were developed (Godden et al., 2001). Ongoing work is examining if the inclusion of dietary variables and cow factors in the model can improve the relationships observed.

**Table 1. Linear relationships between milk urea N (MUN, mg/dl), blood urea N (BUN, mg/dl) and nitrogen-use-efficiency (NUE, milk N/N intake) for individual cow and treatment mean datasets**

|  |  |  |  |
| --- | --- | --- | --- |
| Dataset | Equation† | *P*-value | Adjusted R2‡ |
| Individual cow |  |  |  |
|  | MUN = 3.756(0.245) +1.747(0.066) BUN | <0.001 | 34.6 |
|  | NUE = 0.344(0.001) +-0.006(0.002) BUN | <0.001 | 4.4 |
|  | NUE = 0.346(0.002) +-0.003(0.002) MUN | <0.001 | 6.4 |
| Treatment means |  |  |  |
|  | MUN = 4.085(0.323) +1.646(0.088) BUN | <0.001 | 40.5 |
|  | NUE = 0.358(0.002) +-0.09(0.0005) BUN | <0.001 | 15.8 |
|  | NUE = 0.361(0.003) +-0.004(0.0003) MUN | <0.001 | 15.7 |

†Standard errors shown in parentheses

‡Adjusted R2 determined from the percentage variance

**Conclusions** When relationships were examined using the current long-term and diverse dataset, both BUN and MUN appeared to have limited potential to predict NUE, either at an individual cow or treatment level.

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