

# Understanding nitrogen use in dairy cattle

Ration N content strongly impacts milk production, feed costs and N excreted to the environment

By Larry Chase and Mike Van Amburgh

**For economic and environmental reasons**, dairies should improve the efficiency of nitrogen (N) use in their cattle. They can do this through a combination of ration formulation and feeding management practices.

Nitrogen is the building block of protein, which is usually the most expensive component of purchased feeds for dairies. N is also getting more attention in terms of nutrient management and ammonia emissions.

Crude protein (CP) is the most common term used to describe nitrogen and protein in feeds. CP is simply the total N content of a feed multiplied by 6.25, the factor used because most proteins contain 16% N. Since the calculation doesn't consider differences in how cows use N from feeds, CP is a poor predictor of milk production.

The 2001 Dairy National Research Council (NRC) recommends replacing CP with metabolizable protein (MP) in ration evaluation and formulation.

The MP supplied to a cow is the sum of microbial protein produced in the rumen and the

protein provided by rumen undegradable protein (RUP).

It will take time for the industry to change from CP to MP in ration formulation. However, this is a step in the right direction in terms of refining N use in dairy cattle.

## Efficient N use

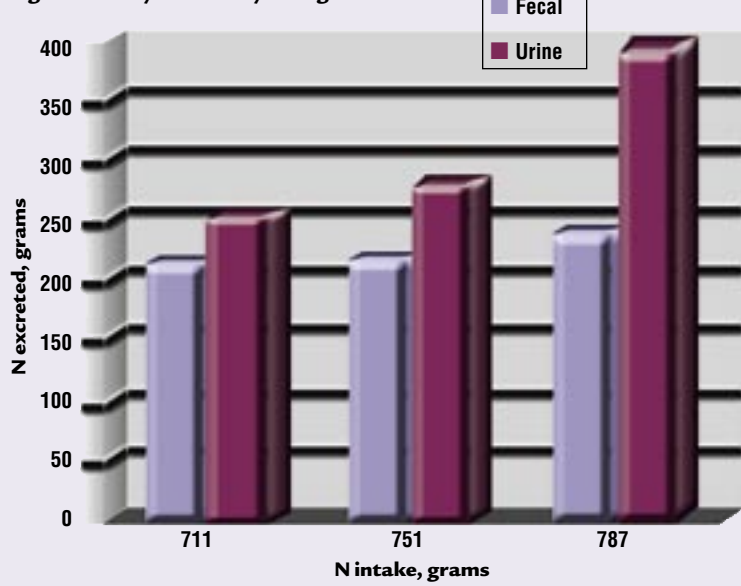
A summary of 62 published research papers with 334 rations showed an average milk nitrogen efficiency (MNE) of 27%, with a range of 16 to 45%. MNE is simply the percent of the intake N contained in the milk produced. The difference between N intake and N in the milk is an estimate of the N excreted via manure. This research indicates that, on average, 73% of the intake N was excreted in the manure.

To determine the MNE in commercial dairy herds, feed industry professionals provided us with rations from 46 dairy herds. Of the 81 rations evaluated, the average MNE was 28.8%, with a range of 21 to 36%. (These numbers should be interpreted with caution as the milk production and dry matter (DM) intakes used were from the ration formulation information, not actual intake.)

To determine how much nitrogen a cow excretes each year, we applied the Cornell Net Carbohydrate and Protein System (CNCPS) model to the data from the commercial herds. The herds averaged 85 pounds of milk per day. Daily N excretion was about 1 pound per day for lactating cows.

Using a 305-day lactation and a 60-day dry period, 332 pounds of total N was excreted per cow per year. The range in daily N excreted in manure was 0.75 to 1.4 pounds per cow.

Figure 1. Dairy cows' daily nitrogen excretion



## FYI

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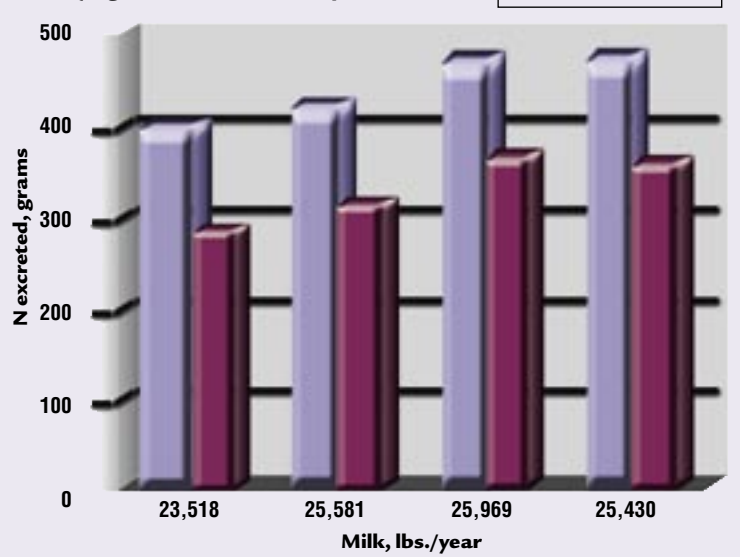
■ For information on the Cornell Net Carbohydrate and Protein System (CNCPS) model see this website: [www.cncps.cornell.edu](http://www.cncps.cornell.edu)

N is excreted in both the solid (fecal) and liquid (urine) components of manure. When nitrogen feeding is close to requirements, the percent of the total N excreted in the urine may be 40 to 50%. As nitrogen intake increases above requirements, this value may increase to greater than 75%.

Potential ammonia production is directly related to the quantity of urinary N. As urinary N excretion goes up, the potential for ammonia emissions is greater. Data from research by PRO-DAIRY's Bill Stone shows that as N intake increased, urinary N increased dramatically but fecal N changed very little. (Figure 1) The three groups of cows in Stone's study averaged 100 pounds of milk per day.

Can we lower the quantity of N excreted without affecting milk production? A recent study at the U.S. Dairy Forage Research Center (Z. Wu and L. Satter) tested a number of protein feeding strategies. (Figure 2) Milk production was similar for three of the treatments, but N intake and excretion was about 50 pounds less for one of them. This indicates there's potential to feed less protein

Figure 2. Nitrogen intake and excretion for cows fed varying levels of ration crude protein



in some situations without affecting milk production. ■

## Action steps

There are several steps you can take to evaluate and improve N efficiency in your dairy herd:

1. Routinely test forages.
2. Adjust rations for variations in forage DM content.
3. Keep accurate track of group or herd DM intakes. Better DM intake monitoring allows you to lower the safety margin on ration protein vs. requirements used in ration formulation.
4. Evaluate the milk urea nitrogen (MUN) status of your herd. MUN values greater than 11 to 13 mg/dl signal opportunities to alter ration protein level.
5. Work with your feed professional to analyze your feeding program. Look specifically at your ration's soluble CP, rumen degradable protein (RDP) and the non-fiber carbohydrate (NFC) levels. These are target levels:
  - RDP = 60 to 65% of the total protein.
  - Soluble protein = about 50% of RDP.
  - NFC = 35 to 40% of the total ration DM.
  - NFC should come from a mix of sources including sugars and starch.
6. When you think you've accomplished these first five steps, evaluate your ration with a pro-

gram that considers amino acids, primarily lysine and methionine.

You may have opportunities to adjust your feeding program and improve the efficiency of N use. A small decrease in ration N can have a large impact on N excreted by cows and the potential for ammonia emissions.

