

Nitrogen Requirements, Feeding Strategies, and Excretion in Dairy Cows

Table 12-2 illustrates the N excretion from two different diet formulation approaches. *Remember that CP is simply the N content multiplied by 6.25.* One diet is high in rumen degradable protein (RDP) and the other diet is lower in RDP, while meeting the overall protein requirement of the cow with higher levels of rumen undegradable protein (RUP, or “bypass” protein). High-producing dairy cows require a proper balance of RUP and RDP to meet their requirements for metabolizable protein (MP). Metabolizable protein is the protein that the cow actually absorbs and uses for production (NRC 2001). The requirement for RUP for lactating dairy cows is 35% to 38% of total CP. When cows were precisely fed to meet RUP and RDP requirements, they excreted 223 pounds of N per year. When cows were fed simply to meet their total CP requirement, however, they excreted 260 pounds of N per year (Table 12-2).

University of Nebraska research in the late 1990s (Grant and Haddad 1998) showed that cows produced the same amount of milk when fed a 17.5% CP diet that was balanced for RUP and RDP as when cows were fed a 19.5% CP diet not balanced for RUP and RDP. In this study, alfalfa was the sole forage and so overall dietary CP content was high. In practice, it is often desirable to feed a blend of legume/grass forages plus corn silage (or other grain silage) to better meet the cow’s requirements for CP, RUP, and RDP. So, as with P, considerable dietary control of nutrient excretion is possible. *A producer should always strive to formulate the lowest CP diet possible that also meets the cow’s requirements for degradable and undegradable protein (RDP, RUP).*

Recently, dairy heifers (570-1,080 lb body weight) were fed total mixed rations containing either 9.6% or 11.0% CP. Reducing N intake by 14% (9.6% vs. 11.0% CP) resulted in a decrease of 29.6%, 19.8%, and 7.4%, respectively, of urea-N, total N, and percentage N excreted in the urine. Ammonia volatilization was reduced in vitro by 28.1% (James et al. 1999).

The dairy cow excretes N via milk, urine, and manure. Milk N represents about 30% of total N intake, manure N from 30% to 40%, and urinary N about 20% to 40% of total N intake. In terms of amount of N excreted daily, urinary N appears to increase more than manure N with higher N intakes. Excessive intakes of dietary N can be monitored by either blood urea nitrogen (BUN) or by milk urea nitrogen (MUN). A BUN level in excess of 18 to 20 mg/dl or a MUN level in excess of 18 mg/dl can be associated with lower reproductive performance, higher feed costs, health problems, and poorer milk production. *A clear relationship between BUN or MUN values and conception rate does not presently exist, but high BUN or MUN values do indicate potential problems.*

Milk urea N analyses can be used as a signal, or “red flag,” to point out potential problems in your feeding program. In particular, high MUN values reflect excessive dietary CP or low rumen degradable nonfiber carbohydrates (NFC). The NFC fraction, usually composed of starch and other sugars, can be low when insufficient grain is fed or grain is improperly processed. Appropriate MUN testing over a period of several months to fine tune a feeding management program can result in

- Precisely meeting nutritional requirements.

- Lower feed costs.
- Increased reproductive performance.
- Increased milk protein yield.
- Minimal N excretion into the environment.

A high MUN (greater than 18 mg/dl) indicates

- Crude protein is too high and/or RDP is too high.
- Rumen fermentable NFC is too low, and/or protein and NFC are not properly combined in the diet.

A low MUN (less than 12 mg/dl) indicates

- Low CP in the rations.
- Improper mix of undegradable and degradable protein, and/or high rumen fermentable NFC.

In the future, MUN will be useful, allowing dairy producers to better manage their feeding programs and minimizing N excretion into the environment.

For more information on MUN testing and interpretation of results, consult *NebGuide G96-1298, Milk Urea Nitrogen Testing* available on the University of Nebraska website: <http://www.ianr.unl.edu/pubs/dairy>.

Currently, MUN analyses are becoming the most widespread means of evaluating a ration's CP or N content versus requirements and if CP is being under- or overfed versus NFCs.

Many dairy producers overfeed CP (i.e., N), which results in excessively high output of N in both urine and manure. Crude protein is often fed at levels to support 25,000 lbs of milk per cow or more annually, even when the herd's actual milk production is substantially less. This practice is expensive and can also negatively affect the environment. The challenge to dairy producers, nutritionists, veterinarians, and other consultants is to formulate diets that meet the cow's protein requirements but also minimize N excretion. Remember, milk yield does not need to be sacrificed to minimize N excretion into the environment.

The following feeding strategies provide ways to control N excretion:

- Increase dry matter intake
- Improve forage quality
- Consider forage protein fraction
- Consider feeding method
- Consider supplemental protein source

The first major goal is to minimize purchased feed N inputs; the second is to improve the dairy cow's efficient use of N. The environmental importance of reducing purchased feed inputs for your dairy is discussed in detail in Lesson 2, Whole Farm Nutrient Planning.

Increase dry matter intake

The percentage of CP required in the ration to provide an absolute amount of protein to support milk production varies with intake level. A 5% increase in intake reduces the CP needed by about 1%. So, more CP could come from homegrown feeds, decreasing the amount of purchased feed required. Also, increasing intake level increases microbial protein synthesis in the rumen, which would decrease the need for higher dietary protein.

Remember, milk yield does not need to be sacrificed to minimize N excretion into the environment.

Improve forage quality

Higher quality legume/grass forage contains more protein, less fiber, and more energy, so it can provide more protein and dry matter to the ration, reducing reliance on purchased protein sources. When purchased N inputs are minimized, the degree of N introduced into the environment from sources outside the farm will be reduced. In general, providing energy from highly digestible, high-quality forages will maximize dairy cow performance and health.

Consider forage protein fractions

Supplement highly degradable forage protein (such as legume silage) with less degradable sources of protein (such as corn silage). Often, this will result in improved milk production at lower CP levels in the diet. Common and effective supplemental sources of RUP include blood meal and feather meal combinations, distillers grains, treated or heated soybeans and other oilseeds, and fish meal.

Consider feeding method

Method of feeding can alter N utilization. Feeding sequence, feeding frequency, and grouping strategy all influence how the cow uses dietary N. Synchronizing the delivery of RDP and rumen fermentable carbohydrate can increase the cow's efficient use of N and decrease N excretion although the mechanism remains undetermined (NRC 2001). It is possible that synchronizing the digestion rates of protein and carbohydrate results in greater microbial protein production. Grouping is especially important to avoid over-supplementing N and other nutrients. A one-group total mixed ration may be easier to manage, but a multiple grouping approach better minimizes protein overfeeding, decreases N excretion, and lowers feed costs.

Consider supplemental protein source

Use protein supplements to allow the cow's RDP and RUP requirements to be met without overfeeding CP. In the future, more emphasis will be placed on the amino acid content of various protein sources. Ultimately, an imbalance of amino acids available to the cow for digestion and metabolism will impair milk and milk protein production.

The primary objective of any dairy feeding program is to achieve profitable milk production. For many producers, this means high levels of milk production. The guidelines in this lesson show how high milk production can coexist with reduced excretion of manure nutrients. Keep in mind, however, that the percentage of nutrients needed for maintenance decreases as milk production increases.