What Factors have the Greatest Impact on Your Dairy Cows’ Nutrient Requirements?
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Lactating dairy cows are high performance animals and, as such, they require a tremendous amount of nutrients. These nutrients are required to support basic life functions, known as maintenance, as well as the production of milk. These basic life functions or maintenance include maintaining a cow’s body temperature, physical activity, and nutrients needed for essential metabolic processes used within cells and tissues. In mid to later lactation dairy cows, additional nutrients are needed to replenish body stores, such as fat (adipose tissue), muscle, and bone, utilized during early lactation. If these reserves are not replaced, dairy cows will not have them available during the next lactation. Additional nutrients also are needed to support growth of the cow during the first and second lactation.

Nutritionists have tried to quantify these requirements for various nutrients since the late 1800’s. From these research studies, requirements have emerged which we use when balancing diets fed to dairy cows. Understanding how requirements vary with milk production, butterfat test and other environmental changes can help you, the farmer, better communicate with your nutritionist and together design feeding programs that best meet the needs of your particular dairy cows.

Priorities for Nutrient Uses

Nutrients are used by lactating dairy cows to support maintenance needs, milk production, growth and replenishing body stores. Development of the fetus also requires extra nutrients, but these requirements are small in relation to the overall needs and are considered part of the maintenance needs of the lactating or dry cow. In early lactation, cows first use nutrients to support maintenance, milk production, and growth (in younger cows). Once these needs are met, the cow can utilize the extra energy and other nutrients to replenish body stores used during early lactation. But, body stores are only replenished after needs for maintenance, milk production and growth are met. These body stores are then used in the next lactation to support milk production when the needs for nutrients cannot be supplied through the diet.

Figure 1: Stage of lactation governs priorities for use of nutrients

- Body Stores
- Growth
- Milk Production
- Maintenance
Practical implications:

1. Body stores for use in the next lactation will not be replaced if inadequate energy, minerals and vitamins are not provided during mid to later lactation of the current lactation. The cow will support maintenance and milk production first, then replace body stores. Cows are more efficient at restoring body fat, muscle and minerals in their bones while milking compared to after they are dried off.

2. In first-calf heifers, if inadequate energy is provided in mid to later lactation, the first-calf heifer will grow and support the nutrient needs for maintenance and milk production. Body stores or fat covering will not be replenished. This often times results in sophomore slump- where second lactation cows do not peak as high as expected since they do not have the body fat stores to mobilize to support higher amounts of milk in early lactation.

Nutrient Requirements

Impact of milk production on requirements: The energy, protein, and mineral requirements of a dairy cow increase tremendously as milk production increases. Figure 2 illustrates how changes in milk production impact the total energy requirements. Energy requirements for maintenance, growth and replenishing body stores do not change significantly with changing milk production. Milk production alone results in the largest change in energy needs. For every 10 lb increase in milk production, 3.2 more Mcal of NEL is required.

![Figure 2: Net Energy for lactation Requirements for a first-calf heifer](image)

However, maintenance becomes less of the total energy needs as milk production increases. As illustrated in figure 3, as milk production increases from 70 to 100 lbs of milk, maintenance needs, as a percentage of the total net energy required, decreases by 5% (30 vs. 25% of total energy needs) and the proportion used to support milk production increases from 64 to 82% of the total net energy required. These same trends occur with other nutrients such as fractions of protein, calcium and phosphorus.
Bottom line: Milk production has the largest impact on the energy, protein, calcium and phosphorus requirements of a lactating cow!

Impact of butterfat content: When we compare the change in requirements with different butterfat contents of milk, they change very little especially relative to nutrient requirement changes seen when milk production changes. As illustrated in figure 4, decreasing the butterfat content of a first-calf heifer producing 70 lbs of milk from 3.5% to 3.0% only decreases the cow’s energy needs by 1.4 Mcal NEI or the equivalent of approximately 4 lbs of milk. Thus, fine tuning the butterfat content of a herd by a tenth or two does not have a major impact on the energy or other nutrient requirements of a lactating dairy cow.
Impact of changing body weight of cows: Changing the body weight of cows has a small impact on the maintenance needs of the cow and thus the overall nutrient needs. As illustrated in figure 5, changing the size of this heifer from 1300 to 1100 lbs of body weight, only changes energy requirements by 1.1 Mcal NEL or the amount of energy needed to produce 3.4 lbs of milk. This small change in needs is due solely to changing requirements for maintenance and not other uses for nutrients. However, changing the weight of heifers or mature cows does greatly affect feed intake and our ability to deliver the needed nutrients to these cows. Thus, it is very, very important that we estimate the average body weight of cows as accurately as possible.

**Figure 5: Effects of Milk Production and Body Weight on Nutrient Requirements**

![Image of bar graphs showing energy requirements for different body weights and milk productions.]

**Practical Implications:**

1. Milk production of first-calf heifers and mature cows has the greatest impact on nutrient requirements for energy, protein, protein fractions (ruminally undegradable protein (RUP) and ruminally degradable protein (RDP)), and minerals such as calcium and phosphorus. Changing the butterfat percentage of milk has only a small impact on nutrient requirements. Thus, it is important that your nutritionist understands the average production for your herd and any changes that occur in production over the feeding year. From an average group or herd milk production, nutritionists may (1) add additional milk production used to balance the diet to account for the variation in milk production of the group of cows and to challenge the fresher cows in the group or (2) add a lead or challenge factor of 10 to 25% in the computer program to achieve this same objective.

2. Body weight of cows does not have a great impact on total requirements. However, first-calf heifers eat less than mature cows and "larger" cows eat more than "smaller" cows. Thus, the concentration of each nutrient (not total amount per se) is adjusted to account for the changing feed intake.

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