Improving dairy production economics via feed efficiency

Improving feed efficiency can improve economics and reduce the environmental footprint of dairy production by boosting the economic return for producers, while lowering methane emissions.

by Davi Brito De Araujo, Global Trace Mineral Program Manager, Trouw Nutrition. www.trouwnutrition.com

Tracking of individual cows within herds has demonstrated that differences can occur in how efficiently some cows turn feed into milk. More efficient cows may generate the same amount of milk as the rest of the herd while consuming significantly less feed.

This trait is also heritable, allowing producers to improve the overall efficiency of their herds over time via genetic improvement.

Tracking efficiency, calculating milk solids

Feed costs continue to be the main cost of milk production. While feed efficiency has been an important metric for many production species, including poultry, swine and beef cattle, it is only starting to be tracked in the dairy industry.

Initial work in this area demonstrates that feed efficiency in lactating cows can range from less than 1.3 to more than 2.0 (Table 1).

Group	FE
High group, mature cows	›1.7
High group, first lactation	›1.6
Low group, all cows	›1.2
One group TMR herds	›1.5
Fresh cows (‹21 days)	‹1.5
Concern	‹1.3

Feed efficiency (FE)
Kg of 3.5% FCM divided by kg of DM consumed.

Example:
30kg of 3.5% FCM ÷ 20kg DM = 1.5kg milk per kg of DM.

FCM = fat corrected milk
DM = dry matter

Table 1. When calculating feed efficiency for a dairy herd, there can be different reference values for cows of different ages or in a different stage of lactation.

When working with lactating cows there can be different ways to define feed efficiency depending on the metrics used.

Some common examples include:

- Kg of energy corrected milk (ECM) per kg of dry matter consumed.
- Kg of milk solids per kg of dry matter consumed.
- Kg of milk per hectare (for cows on pasture).
- Kg of milk nitrogen per kg of nitrogen consumed.
- Kg of milk solids per unit of carbon dioxide output or greenhouse gas generated.

The most commonly used measurement in the US tends to be kg of milk solids per kg of dry matter consumed.

Alternatively, milk can also be corrected for fat and/or energy using different baselines.

Milk yield (kg)	Feed efficiency
25	1.25
27	1.32
30	1.38
32	1.44
34	1.49
36	1.54
38	1.58
40	1.63

Table 2. Data from research completed at The Ohio State University about the relationship between feed efficiency and milk yield.

For example, fat corrected (FCM) milk in the US typically uses 3.5% as the measure, whereas in some European countries 4% is standard.

According to researchers' data at The Ohio State University, improving feed efficiency by making dietary changes can boost the amount of milk cows produce during the lactation period.

Changing dietary elements to improve herd feed efficiency from 1.3kg milk/kg dry matter to 1.5, lowers the dry matter intake required for cows to produce a certain amount of milk.

This can result in a significant increase in income over feed costs.

Feed efficiency and dietary elements

When working to improve feed efficiency in a dairy herd, it can be important to track changes over time to identify what caused the shift.

Factors that can influence feed efficiency include milk production and component yield (see Table 2), feed intake, forage quality and quantity, cow age, ration protein levels and composition of the diet, body weight, environmental stress, exercise, pregnancy and feed additive use.

The four main elements considered are feed digestibility (Fig. 1), which relates to feed quality; days in milk as herds can become less

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Fig. 1. As forage dry matter becomes more digestible, feed efficiency improves.

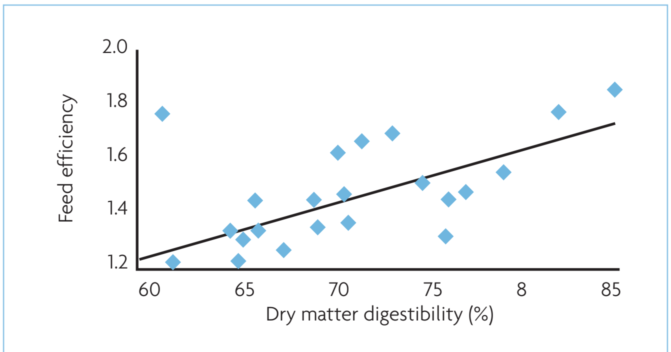
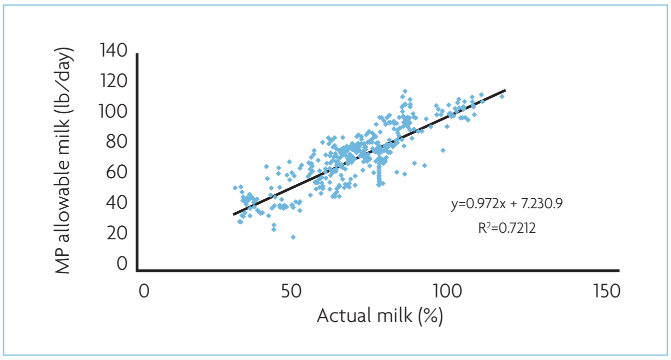


Fig. 2. As levels of metabolisable protein improve, milk yield increases. (VT Dairy Farm Sustainability Project, 2002).



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efficient during the second half of the lactation; somatic cell count because poor udder health can result in lower milk yields; and rumen acidosis (SARA) which affects digestion and impedes feed passage. There can also be a genetic factor to feed efficiency.

In addition to providing more digestible feeds – feeds that release more energy and protein – digestibility can be improved to increase feed efficiency. The newly revised NASEM 2021 guideline for dairy has changed dietary protein ration requirements almost across the board.

An improved understanding of the role that dietary, metabolisable protein (MP) plays for lactating dairy cows has established relationships between protein in the diet and milk yield (Fig. 2).

Within the catch-all term protein some elements are particularly important, especially when considering the needs of ruminal microbes.

These include amino acids and peptides (short chains of amino acids). Ammonia is also an important nutrient for ruminal microbes, which can be provided by a range of sources including grass silage and urea.

Sources of amino acids include rumen degraded microbial protein, rumen undegraded protein (RUP) and rumen protected amino acids – a more expensive, commercial option.

Among amino acids, several are considered essential but are not provided at required levels within most feed ingredients – typically a feed ingredient may have enough of one, but not all.

Despite their higher price, the potential benefits gained from using rumen-protected amino acids can include an increase in milk protein levels, an overall milk yield increase and higher milk fat levels.

In feeding trials done at The Ohio State University, lactating cows were given either a control diet or a diet balanced for amino acids. Although total crude protein levels for the diets were the same, cows on the balanced amino acid diet generated more milk, and less milk urea nitrogen (MUN) and had an improved income over feed cost (IOFC) result.

Milk urea nitrogen refers to the rumen bugs' ability to capture ammonia present in the rumen for conversion to microbial protein. MUN is a measure of urea nitrogen in the milk indicating the efficiency that ammonia was converted to microbial protein in the rumen.

Levels that are too high can result in reduced nitrogen efficiency and start to reduce fertility and rumen function.

Adjustments to the form of protein and level in the ration may be required to correct a high or low MUN value.

Management changes that can influence overall efficiency include increasing the number of lactations per cow, reducing the age of first calving, and limiting feed waste.

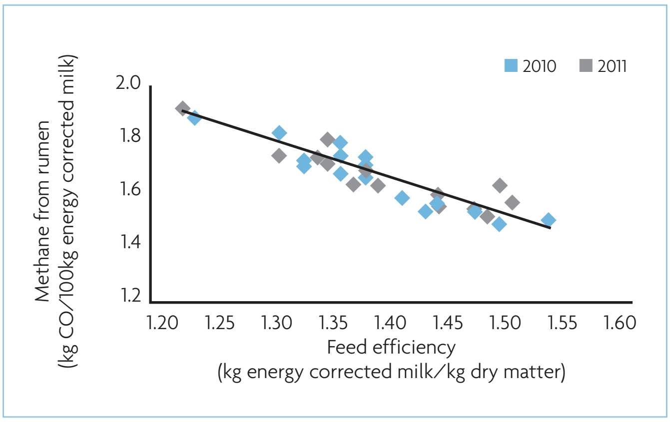

Fig. 3. Farm data has established a correlation between feed efficiency and methane generation by dairy cows.

The value of a high-efficiency cow

Cows were tracked at five commercial farms, examining the performance of the top 25%, and the bottom 25% of the cows. It was found that highly efficient cows generated about 49% more profit – depending on input costs and milk price.

The least efficient cows tended to eat more dry matter than highly efficient cows and produced about 10kg less milk per day. In addition to producing more and eating less, cows with high feed efficiency have been found to generate less methane and produce less manure.

A high correlation has been found between feed efficiency and methane production (see Fig. 3).

According to the FAO, livestock production is responsible for 14.5% of all global greenhouse gas emissions. Within that, the dairy sector accounts for about 2.2% of the greenhouse gas emissions. Therefore, the more productive dairy cows are, the less methane or greenhouse gas they release.

Feed efficient herds and heritability

Beyond tweaking diets, it is possible to breed dairy herds to achieve higher feed efficiency. This trait is heritable across generations.

Establishing a herd of more efficient cows can help a farm reduce its total carbon footprint. It is important to select for additional characteristics including health and longevity because multiple elements are needed to ensure the best economic return.

Evaluating dairy herd feed efficiency is an outgrowth of a common assessment that is ongoing in other production species. Feed efficiency is a parameter that can be tracked and improved. Managing diets to provide optimal levels of energy and protein or amino acids can help to increase cow productivity and well-being.

Management changes and breeding practices can also improve overall herd efficiency.

These measures can result in more efficient cows, that generate less waste and produce less methane – helping to improve the overall carbon footprint of the farm. ■