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Improving Feed Efficiency in Dairy Cattle

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The United States dairy production has continued to grow despite competition for land and other agricultural resources from other agronomic and livestock/poultry alternatives. More efficient utilization of resources has now become a major objective of many dairies as they increase the size of their dairy herd despite a limited land base. In the Midwest and Northeast U.S. this growth has been driven by increases in use of corn silage, increased percentage of forage in the ration, and increased use of by-product feeds. Recently, the more profitable and successful dairy enterprises are placing focus on feed efficiency.

Feed efficiency has been a major metric used in measuring production and profitability of poultry, swine, and feedlot cattle. Recently, feed efficiency has become a more important measurement in dairy production as feed prices increased from historical levels and with more focus on environmental implications with limited land bases. A leading U.S. dairy nutritionist, Dr. Mike Hutjens of the University of Illinois has spoken to this point for many years at many dairy conferences as well as other venues. Dr. Hutjens has used an optimal range of 1.4-1.8 lbs. ECM/lb. of dry matter intake (ECM=energy corrected milk) as optimal. However, there are many other metrics which can be used that may more closely relate to a specific desired outcome.

Gross feed efficiency is some ratio of feed required to produce a certain amount of milk. How we define milk outputs and feed inputs leads to many different definitions of feed efficiency. Milk output can be defined in terms of yield (milk, fat, and/or protein), cheese yield, milk energy, and milk dollars. Feed inputs can be defined as gross, digestible, metabolizable, or net energy; dollars; and other methods. Recently, Chr. Hansen sponsored a dairy nutrition symposium with a feed efficiency theme. Our panel of consultants explored these various metrics as well as other non-traditional measurements. Traditional measures of feed efficiency in dairy operations as follows:

- Feed costs per 100 lb or cwt. (reflects milk yield, shrink, and feed costs)
- Feed costs per lb of dry matter (reflect feed ingredients selection)
- Income over feed costs (reflects profit margin)
- Feed efficiency (evaluates feed conversion to milk yield), ie. lb Feed/lb ECM

Measuring feed efficiency in an economic form is challenging and not constant. It involves fluctuating market conditions, biological issues related to feed production and manipulating cattle biology and herd structure.

There are four key factors to improving dairy feed efficiency:

- Forage quality/ration digestibility
- Maintaining optimal rumen function and minimize rumen acidosis
- Pregnancy rate
- Somatic cell count

Forage quality has a major impact on feed efficiency. Producing, harvesting, and storing forage with a high and consistent NDFd (d=digestibility) is the key to efficient use of forages. High quality alfalfa, grass, and corn silage forage has helped producers both increase their feed efficiency (FCM per unit of dry matter intake) and also increase the percentage of forage in the ration which generally improves the economic efficiency (income over feed cost).

> “Stimulating the rumen fermentation while stabilizing the rumen environment will improve nutrient and fiber digestibility.”

Increasing the percentage of high quality forage in the ration of early lactation dairy cows generally can result in a healthier rumen and lower incidence of rumen acidosis. Stimulating the rumen fermentation while stabilizing the rumen environment will improve nutrient and fiber digestibility. Rumen acidosis will decrease feed efficiency. Feed additives such as probiotics, rumen buffers, monensin, and yeast plus utilizing silage inoculants can improve feed efficiency by improving digestion and/or nutrient availability. With forages, “effective” fiber levels (fiber length) should be another consideration when processing forages. Consideration of adequate “effective” fiber required to maintain the rumen fiber “mat” helps maintain optimal cow rumination activity and rumen function.

Pregnancy rates have a major influence on days in milk in a herd. Higher pregnancy rates decrease the calving interval and decrease the average days in milk of a herd. Reducing the days in milk leads to a higher conversion of feed energy to milk production at the expense of growth and weight gain. Cows in early lactation will lose body condition (weight) and will use that body energy for higher milk yield. Conversely, as cow’s pregnancy advances in late lactation, feed efficiency declines as fetal nutrient requirements increase.

Somatic cell count (SCC) is a measurement associated with the level of mastitis in a herd. Mastitis is associated with reduced milk production in about 70% of the cases. Frequent and accurate determination of bulk milk tank SCC will provide a general indication of a herd’s mastitis status. Research has demonstrated that milk losses associated with elevated SCC are higher than previously thought. This lowered milk production has an adverse effect on dairy feed efficiency.

Other key factors associated with dairy feed efficiency include age of cows, degree of grain processing, protein level and form, body weight change, milk production, high fat test, environmental stress, level of exercise (grazing), pregnancy, feed additives, rBST, and cow genetics.

Guidelines from Dr. Mike Hutjens (2013) presented at a recent Chr. Hansen producers seminar are as follows:

Dairy Efficiency: kg of 3.5% fat corrected milk divided by kg of DM consumed

High group, mature cows	> 1.7
High group, 1st lactation	> 1.6
Low group	> 1.3
One group TMR herds	> 1.5
Fresh cows	< 1.5
Concern (one group)	< 1.3

Example: 33 kg milk / 22 kg DMI = 1.5

3.5% Fat Corrected Milk (FCM) = (0.4324 x kg of milk) + (16.216 x kg of milk fat)

Energy Corrected Milk (ECM) = (12.28 x kg of fat) + (7.13 x kg of protein) + (0.323 x kg of milk)

When calculating feed efficiency, milk yield should be corrected for milk components as more nutrients are needed as milk fat and protein content increase. The formulas shown above are the more common measurements used in the US market.

There are many biological tools to improve feed digestibility, animal performance and improve feed quality and preservation. Feed additives and silage inoculants are tools to increase dairy feed efficiency. Criteria such as collecting and measuring data, interpreting data, and implementation of measures to improve feed efficiency are important considerations. Changes in feed efficiency should be monitored to evaluate the impact of feeding and management changes on a dairy operation. However, comparisons between herds should be done very carefully.

> "Feed additives and silage inoculants are tools to increase dairy feed efficiency."

Feed digestibility is receiving much more attention in the USA as the cost of forages and grains have increased. The use of BMR varieties of corn for silage, corn kernel processing of corn silage, storing/feeding high moisture grains, "Shredlage®" method of harvesting of whole-plant corn for silage, and controlling dry matter intake are all management considerations that will increase dairy feed efficiency.

A real life example of a USA dairy is presented in Table 1 in a Pennsylvania State publication (2012). This farm had a low production and low feed efficiency. By controlling feed intake, there was an opportunity to improve feed efficiency and income over feed costs. Improving forage quality with increased digestibility could accomplish the improvement. There are many opportunities to improve feed efficiency without increasing production.

Poor feed efficiency has implications for environmental concerns. The reduction in manure volume as feed efficiency improves could potentially extend the farm's manure storage capacity and reduce risks associated with spreading manure when conditions are less than ideal. Reductions in nitrogen and phosphorus would allow more flexibility in how manure is applied to various fields. Improving dairy feed efficiency has allowed dairy producers to expand their dairy operations without increasing their land base to accommodate nutrient management plans/requirements.

Although not related to biological feed efficiency, feed wastage affects the whole farm feed efficiency. Feed wastage is associated with excess dry matter losses during silage fermentation, heating of the silage bunker/pile face and TMR, refusals and wastage at feed bunk, and spilled feed. Wind and birds can fly away with the feed inventory and rain damage can lead to unpalatable feed. Storing under cover or covering forages and feed with plastic or tarps prevents losses.

In conclusion, the use of dairy feed efficiency as a management decision tool will continue to evolve as a key metric for modern dairy production. Considerations for the biological and feed inventory factors should both be considered with whatever feed efficiency measurement(s) is/are selected. Forages have the greatest effect on feed efficiency.

Table 1: Potential increase in IOFC (Income Over Feed Cost) by improving feed efficiency

Milk (lb)	Fat (%)	Protein (%)	3.50% FCM (lb)	ECM (lb)	Dry Matter Intake (lb)	Feed Efficiency	IOFC ($/cow/day)	Potential Improved (IOFC, $/cow/day)
60	4.60	3.20	71	68	52	1.32	3.69	
60	4.60	3.20	71	68	50	1.37	4.00	0.31
60	4.60	3.20	71	68	48	1.43	4.33	0.64
60	4.60	3.20	71	68	46	1.49	4.63	0.94

A real farm situation. Improving feed efficiency (FE) has the potential to increase income.
Assumed milk price of $20.00/cwt and feed prices from July 2012.