Feed Efficiency and Its Impact on Feed Intake

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This fact sheet reflects the best available information on the topic as of the publication date.
Date 6-20-2006

This Feed Management Education Project was funded by the USDA NRCS CIG program. Additional information can be found at http://www.puyallup.wsu.edu/dairy/joeharrison/publications.asp

This project is affiliated with the LPELC http://lpe.unl.edu

USDA United States Department of Agriculture

NRCS

Introduction

This fact sheet has been developed to support the implementation of the Natural Resources Conservation Service Feed Management 592 Practice Standard. The Feed Management 592 Practice Standard was adopted by NRCS in 2003 as another tool to assist with addressing resource concerns on livestock and poultry operations. Feed management can assist with reducing the import of nutrients to the farm and reduce the excretion of nutrients in manure.

Feed efficiency (also referred to as dairy efficiency) can be defined as pounds of milk produced per pound of dry matter (DM) consumed. Beef, swine, fish, and poultry industries have used feed efficiency (feed to gain or gain to feed ratio) as a benchmark for profitability. Monitoring feed efficiency or FE in the dairy industry has not been used as a common benchmark for monitoring profitability and efficiency of converting nutrients to milk yield. The “new focus” on maximizing efficiency reflects the fact that as cows consume more feed, digestive efficiency decreases because the relationship between net energy-lactation intake and milk production is subject to diminishing returns. The “traditional focus” was that as cows consume more feed to support higher milk production, the proportion of digested nutrients captured as milk is proportionally higher.

Economics of Feed Efficiency

With lower milk prices, one way to maintain profitability without sacrificing milk production or herd health is by enhancing FE. Table 1 is an example of how improving FE impacts the bottom line. Herd A produced 80 pounds of milk when consuming 57 pounds of DMI, resulting in a FE of 1.40. Herd B produced the same amount of milk, but the cows consumed only 50 pounds of dry matter, for a FE of 1.60. Assuming feed costs of $0.07 per pound of dry matter, Herd B has a lower feed cost of $0.49 per cow per day compared to Herd A. In addition, Herd B with the lower feed intake and higher feed efficiency will have lower nutrient excretion as manure. This will be important as manure regulations for whole-farm nutrient management are enforced by local, state, and national government groups.

Optimizing feed intake is the "magic" term; not maximizing DM intake (DMI). Higher nutrient demand for higher milk production led to maximum DMI to meet higher requirements. The more DM the cow eats, the more she will milk. For Holstein cows, each additional pound of DM consumed could lead to an additional two pounds of milk. If one pound of DM costs seven cents, two pounds of milk can be worth 30 cents added income or 23 cents more income over feed costs. This guideline assumes two points.

- Ration digestibility is constant (but digestibility actually declines with increased DMI).

- All the nutrients consumed are converted to milk production after maintenance needs have been met (but this is not always true as growth and/or weight gain occurs).

Composition of the diet (forage to grain ratio) and dry matter intake (multiples of maintenance) has marked effects on digestibility and subsequent energy values. Diets that do not promote optimal rumen fermentation will result in an over-estimation of energy values and will impair health.

Factors Impacting Feed Efficiency

Feed efficiency values in the field can vary from 1.1 to 2.0 (Table 2). The following factors will shift FE values.

- Reducing days in milk can lead to higher FE values as cows direct more nutrients to milk production at the expense of growth and weight gain. Cows losing body condition or body reserves will have high FE values as these nutrients can be captured as higher milk yield

- Age or lactation number (first lactation cows) can lead to lower FE values as young cows divert nutrients to growth in mid and late lactation. Expect FE values for young cows to be 0.1 to 0.2 units lower than mature cows.

Table 1. Impact on feed costs in two herds with different feed efficiencies.

Measurement	Herd A	Herd B
Milk, lb/d	80	80
DMI, lb/d	57	50
Feed efficiency	1.40	1.60
Milk income @ $12/cwt	$ 9.60	$ 9.60
Feed costs @ $.07/lb dry matter	$ 3.99	$ 3.50
Income of over feed costs	$ 5.61	$ 6.10
Cost to produce 100 lbs milk	$ 4.99	$ 4.38

- Pregnancy requirements reduced FE values as the fetus' requirements increase during late gestation (this impact will be small).

- Fresh cows (less than 21 days in milk) may have FE values below 1.2 if cows achieve higher DMI (desirable) relative to milk yield. If FE values are over 1.4, cows could be mobilizing excessive body condition (undesirable) which also will be reflected in high milk fat test (undesirable).

Table 2. Benchmarks for feed efficiency comparisons.

Group	Days in milk	FE (lb milk/lb DM)
One group, all cows	150 to 225	1.4 to 1.6
1st lactation group	<90	1.5 to 1.6
1st lactation group	>200	1.2 to 1.4
2nd + lactation group	<90	1.6 to 1.8
2nd + lactation group	>200	1.3 to 1.5
Fresh cow group	<21	1.2 to 1.4
Problem herds	150 to 200	<1.3

- Cows gaining body weight will have lower FE values as nutrients are stored as body condition or fat. This decline in FE must occur if cows lose body weight in early lactation. Lower FE values in late lactation can be desirable. Future FE values can be adjusted if average daily gains are available (daily weights).

- Higher digestible forages will increase FE values as more nutrients are available for productive functions. Dry matter digestibility (DMD) and NDF digestibility (NDFD) tests will be useful benchmarks that will impact FE.

- As NDF (neutral detergent fiber) percent in the ration dry matter increased, FE declined from 1.8 to 1.4 based on Journal of Dairy Science data from 2002 to 2004. FE values remained constant at 35 percent NDF and above.

- Stimulating rumen fermentation while stabilizing the rumen environment will improve nutrient and fiber digestibility. Rumen acidosis will reduce FE values because digestibility has been reduced.

- Excessive heat and cold stress and walking distances will reduce FE values as more nutrients are needed for maintenance requirements.

- Feed additives (such as rumen buffers, ionophores, yeast cultures, and fermentation/digestion aids) and silage inoculants can improve FE values by improving digestion and/or nutrient availability.

- Injecting BST can improve FE values as cows divert more nutrients to milk production.

Fine Tuning Feed Efficiency

Management factors listed below can be used to evaluate and refine FE values measured on dairy farms.

- Determining actual feed intake is critical for an accurate FE value. Feed refusals should be removed (subtracted) as this feed has not been consumed. If a dairy manager targets four percent feed refusal with 50 pounds of dry matter offered, the correct value to use in the calculation is 48 pounds instead of 50 pounds. Weekly dry matter tests should be conducted on the farm to correct for variation in dry matter intake due to changes in wet feeds or precipitation.

- Correct for milk components as more nutrients are needed as milk fat and protein content increases. Values reported in this paper are based on 3.5 percent fat corrected milk (3.5%FCM). The following formulas can be used:

  Equation 1: 3.5% FCM = (0.4324 x lb of milk) + (16.216 x lb of milk fat)

  Equation 2: 3.5% fat and protein corrected milk (lb) = (12.82 x lb fat) + (7.13 x lb protein) + (0.323 x lb of milk)
  In 476 treatment observations in a data set compiled from journal articles by Agri-King, the difference between 3.5% FCM corrected and uncorrected milk for fat ranged from -0.28 to +0.41 units reflecting the need to adjust for milk fat.

- On the Holstein farms, use the thumb rule of adding or subtracting one pound of milk for every one-tenth percentage point change above or below 3.5 percent fat test. For example, if a herd averages 70 pounds of milk with a 3.9 percent milk fat, the estimated pounds of 3.5% FCM would be 74 pounds instead of 70 pounds.

- Cows having small body weights (i.e. heifers or Jersery's) favor higher feed efficiency due to lower nutrient requirements for maintenance. Adjusting for differences in body weight within breed may be a useful correction, i.e. metabolic body size.

Future Opportunities

New software programs will be developed to allow the use of on-farm data to produce standardized FE values (similar to management level milk or

150 day milk). Using these spreadsheets, managers could enter days in milk, body weight, milk yield, milk fat test, milk protein test, changes in body condition score, environmental temperature, walking distances, and lactation number and the software will adjust values using research-based equations. When a management change is made, FE will reflect the impact in the herd.

Summary

- Feed or dairy or FE reflects the amount of fat-corrected milk yield produced per unit of dry matter consumed with an optimal range of 1.4 to 1.9 pounds of milk per pound of dry matter.

- Days in milk, age, growth, changes in body condition score, walking distances, body weight, forage quality, feed additives, and environmental factors will impact feed efficiency values.

- Dairy managers should monitor changes in feed efficiency as feeding and management changes occur on their farms to evaluate the impact of the change.

- By increasing feed efficiency, less manure and greater milk yield per unit of dry matter consumed will result in an improvement in the environment and profitability of the dairy operation.

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Project Information

Detailed information about training and certification in Feed Management can be obtained from Joe Harrison, Project Leader, jhharrison@wsu.edu, or Becca White, Project Manager, rawhite@wsu.edu.

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