Making Dollars and Sense of Feed Efficiency

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Feed efficiency can be defined as pounds of milk produced per pound of dry matter intake (DMI) consumed. Beef, swine, fish, and poultry industries have used feed efficiency (feed to gain ratios) as a benchmark for profitability. Monitoring feed efficiency (also referred to as dairy efficiency) in the dairy industry has not been used as a common benchmark for increasing profitability and evaluating dry matter intake relative to milk yield.

With lower milk prices, one way to maintain profitability without sacrificing milk production or herd health is by enhancing feed efficiency. Table 1 is an example of how improving feed efficiency impacts the bottom line. Herd A produced 80 pounds of milk consuming 57 pounds of DMI for a feed efficiency of 1.40. Herd B produced the same amount of milk, but the cows consume only 50 pounds of dry matter, for a feed efficiency 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. Higher income over feed costs could be the difference between staying profitable or losing money.

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.

Table 1. Impact on feed costs in two herds with different feed efficiencies (Source: Casper, Hoard's Dairyman, 2003).

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

Optimizing feed intake is the "magic" term; not maximizing DMI. Higher nutrient demand for higher milk production led us to believe that maximum DMI must be achieved to meet these requirements. The more DMI the cow eats, the more she will milk. For Holstein cows, each additional pound of DMI consumed could lead to an additional two pounds of milk. If one pound of dry matter costs seven cents, two pounds of milk can be worth 25 to 30 cents more income or 18 to 23 cents more income over feed costs. This guideline assumes two points.

1. Ration digestibility is constant (digestibility declines with increased DMI).

2. All the nutrients consumed are converted to milk production after maintenance needs have been met (no growth or weight gain for example).

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 ruminal fermentation will result in an overestimation of energy values.

Factors Impacting Feed Efficiency

Feed efficiency (FE) values in the field can vary from 1.1 to 2.0. High producing herds fed a one group TMR will range from 1.4 to 1.6. Early lactation mature high groups of cows can approach 1.8. If cows lose body weight, FE values will increase as nutrients from body weight mobilization can contribute to milk yield. The following factors will shift FE values.

1. 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.

2. 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.

3. Pregnancy requirements reduce FE values as the fetus requires additional nutrients.

4. Cows gaining body weight will have lower FE values as nutrients are stored as body condition or fat.

5. Digestible forages will enhance FE values as more nutrients are available for productive functions.

6. Stimulating rumen fermentation while stabilizing the rumen environment will improve nutrient and fiber digestibility. Rumen acidosis will reduce FE values.

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

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

9. Using bST may improve FE values as cows divert more nutrients to milk production.

Fine Tune Feed Efficiency
The following guidelines can be used to refine FE values measured on dairy farms.

1. 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 formula may be used:

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

2. On the dairy farm, 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 3.9 percent milk fat, the estimated pounds of 3.5% FCM would be 74 pounds instead of 70 pounds.

3. Dry matter intake must be corrected for weigh backs or feed refusals. For example, a herd manager delivers 50 pounds of dry matter per cow with a four percent feed refusal. The number to use in calculating FE is 48 pounds, not 50 pounds.

4. Another comparison is FE value compared to the milk yield using the “13 pound tax” for Holsteins (adjustment for maintenance). The “13 pound tax” for Holsteins reflects the initial 10 megacalories (Mcal) of net energy needed for maintenance functions (higher for cows on pasture and experiencing heat/cold stress).

   Milk yield: (DMI consumed - 13 pounds of DM) x 2

   For example, a herd consuming 50 pounds of dry matter could support 74 pounds of milk (50-13 equals 37; times 2 equals 74 pounds of milk). For Jersey cows, use 10 pounds of dry matter for maintenance.

Why The Interest In DM Intake?

- Feed costs are the largest cost of production
- Maximizing dry matter intake is may not be the most economical justified
- Feed weigh backs are controversial from empty bunks to 10% remaining
- Feed efficiency is "the" measure for beef, swine, poultry, and fish; but not monitored in dairy cattle.
- Feed efficiency in lactating cows can vary from 1.8 to 1.2

DMI: 13 Pound Tax

DMI needed for maintenance and milk production

13 pounds for Holstein maintenance tax
(DMI – 13 lb) multiplied by 2

Example: (53 lb – 13 lb) X 2 = 80 lb milk

10 pounds for Jersey maintenance tax

DMI: Dairy Efficiency

Dairy Efficiency: Pounds of fat corrected milk divided by pounds of DM ***consumed***

Excellent >1.7
Concern < 1.3

Example: 75 lb milk / 50 lb DMI = 1.5

3.5% FCM = (0.4324 x lb of milk) + (16.216 x pounds of milk fat)

Dairy Efficiency

- Compare different production strings (high string raised value)
- Impact of forage quality (raises value)
- Age of cows (older cows higher)
- Body condition score (weigh loss raises)
- High fat test (raises if corrected)
- Rumen acidosis (reduces value)

POWER IS IN CHANGES OVER TIME

Tennessee Research on DE

- 13 Holstein herds with 34 monthly measurement over 14 months
- Herd size: 47 to 634 cows
- Evaluated cool vs hot environment (> 80 F), ration protein, ration fiber, ration forage level, milk yield, and size
- Ration values: 196 DIM, 65.1 lb milk, 3.71% fat test, 20.5% ADF, 33.2% NFD, and 47% forage with 1.36 DE or 1.50 (160 DIM corrected)
- 8 out 13 herds > 1.4 (some months)
- 3 out 13 herds > 1.4 (all of time)

Tennessee Relationships

- Milk yield and DE positive (R square 0.49)
- DIM and DE negative (R square 0.28)
- Herd size and DE no relationship (R square 0.02)
- Dry matter intake and DE slight negative (R square 0.10)
- Crude protein and DE no relationship (R square of 0.003)
- Forage percent and DE slight negative (R square of 0.18)
- Heat and DE significant (warm = 1.356; cool = 1.445 at P < 0.05)

University of Wisconsin Field Data

Herd	Forage (lb DM)	Milk (lb)	Total (lb DM)	DE	RHA (lb/year)
N (all)	26.8	45	40.1	1.12	16,600
P (high)	27.2	94	57.4	1.64	21,000
B (high)	30.6	80	55.4	1.44	23,700
S (high)	31.1	100	62.7	1.60	26,600

U of WI--Herd S

Pen (#)	Cows (#)	Lact (#)	DIM (days)	Milk (lb)	DMI (lb)	DE
1	115	1.2	143	81	48.9	1.66
2	114	3.0	117	100	62.1	1.61
3	115	2.0	251	79	52.9	1.49
4	114	2.0	293	77	52.9	1.46
5/6/7	68	2.6	96	79	43.0	1.84
Herd	576	2.1	187	83.6	52.7	1.59

A Look at a Wisconsin Herd

Group	DIM (day)	Milk (lb)	DMI (lb)	Feed ($)	IOFC ($)	DE (lb /lb)
1st fresh	27	42	44	3.06	1.98	0.95
1st high	124	79	50	3.15	6.33	1.58
1st PG	225	64	53	2.67	5.01	1.21
2nd fresh	20	60	52	3.63	3.57	1.15
2nd high	80	101	58	3.65	8.47	1.74
2nd PG	276	67	51	2.85	5.19	1.31

Figure 3. Response in Feed Efficiency to ration dry matter digestibility (DMD) by lactating dairy cows.
FE=0.032+0.02*DMD, R^2=.59, P< .01.

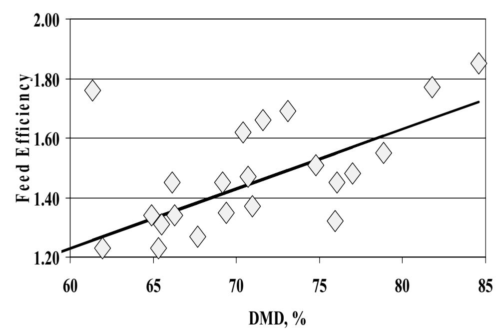


Figure 1. Frequency distribution of dry matter digestibility (DMD) in 29,817 Haylage samples

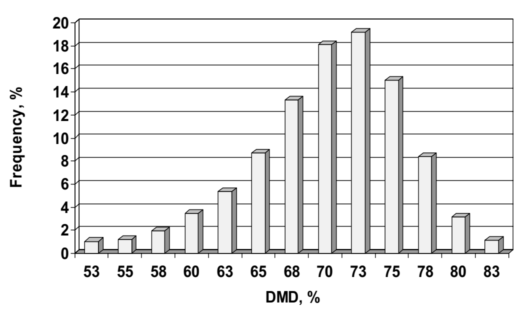


Figure 2. Frequency distribution of dry matter digestibility (DMD) in 30,422 corn silage samples

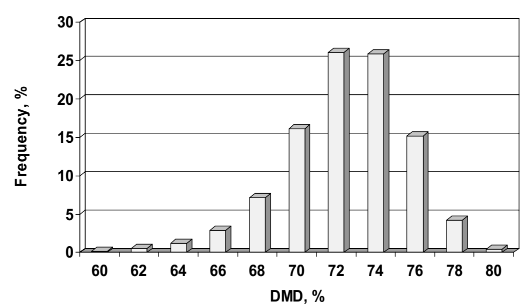


Figure 4. Effect of Silo-King® application rate on dry matter (DM) digestibility.
DM digestibility =55.9 + 1.72X; r^2=.65, P< .01.

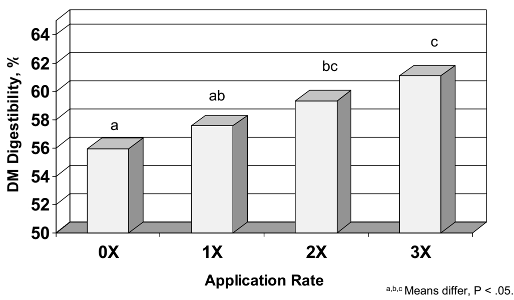
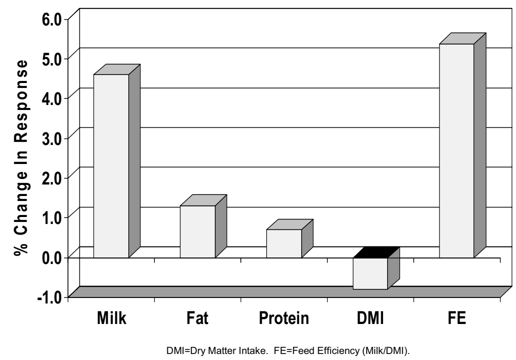
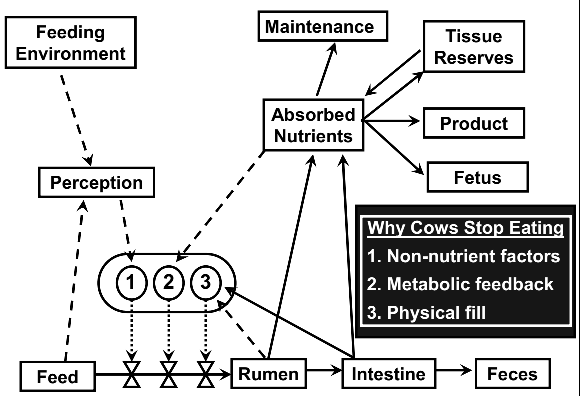


Figure 5. Response to changes in ration balancing and fortification to improve ration digestibility.



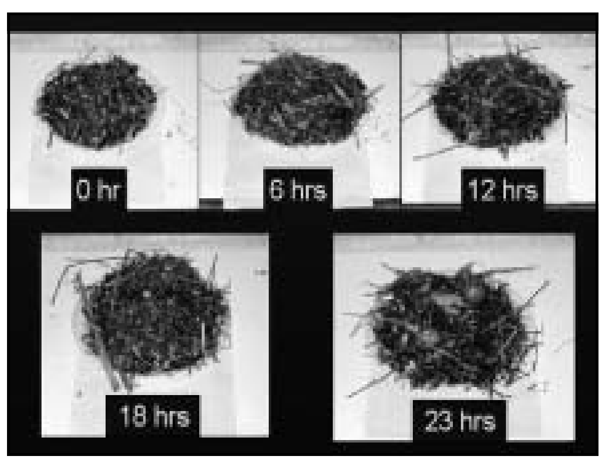


Effect of Heat Stress on Dry Matter Intake and Energy Balance (60 lb milk)

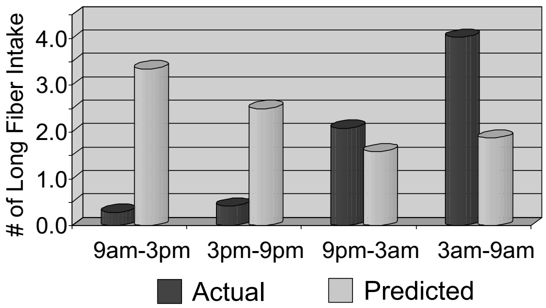
Temp (deg F)	Maint (50 deg)	DMI Need	DMI Expect	Milk (lb)	Water (gal)
68	100	40	40	60	18
86	111	42	37	51	21
95	120	43	36	40	32

Minimizing Sorting

- **Feeding more frequently (ask the herd)**
- **Pushing up more frequently**
- **Reduce long forage particle size (1 to 2 in)**
- **Add water (5 to 7 pounds per cow)**
- **Consider wet molasses (1/2 to 1 lb per cow)**
- **Remove feed refusals**



Long Particle Intake Data



Additional DMI Factors

* Total wet feed intake per cow may be 110 to 120 pounds per day
* Lame cows can reduce DMI by 6 to 8 pounds for score 5 lame cows
* Largest meals occur after milking (15 to 20 percent per meal in 2x)
* 10 to 12 meals per day with TMR and "good " bunk management
* Weigh backs of 2 to 4 percent of total and no sorting (Penn State Box)

Feeding a TMR Free Choice

- 2-4 percent weigh back (orts)
- Weigh back is uniform (+/- 10% Penn State box from original)
- Feed is available > 20 hours a day

TMR GUIDELINES

- Feed available over 20 hours a day
- In the holding pen and parlor < 1 hr
- Weigh backs should average 2-4%
- Avoid rations over 55% moisture from fermented feeds, under 40% moisture
- Reformulate when dry matter intakes change by 2 lb/cow/day
- Reformulate if wet ration ingredients changes 5% or 2 lb D.M. per cow