Feed efficiency – is 2008 the year?

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As feed costs continue their inexorable rise, financially conscience dairy farmers are often advised that their salvation is to increase the efficiency with which they use their feeds; but is higher feed efficiency always a good thing?

According to the dictionary, 'efficiency' has two definitions:

- The quality or state of being efficient.
- The ratio of the useful work done to the energy input.

When we are considering feeding ruminants, these two things are quite different. Being 'efficient' in the use (or digestion) of feed is important to maximise the investment in feed. A higher feed conversion efficiency (FCE) – the ratio of milk produced to feed dry matter intake, however is not always more profitable. This is because of the ruminant's unique capability of consuming usually lower cost high fibre feeds such as forages, at a lower 'efficiency'. Reaching for a higher FCE can also be dangerous – it could easily be achieved through excess weight loss.

Consider two theoretical rations, both capable of producing 32 litres of milk with no weight loss (Table 1). Ration A has a FCE of 1.65 l milk/kg DMI, while Ration B can only manage 1.51 l milk/kg DMI. However, production cost also has to be taken into consideration when ranking diets on FCE. In this example, ration B is 1.67 Euro cents per litre cheaper than ration A, which puts FCE figures into perspective. If we are going to use FCE as a measure for ruminants, we should consider the cost of the feed against the value of the output (ration B might produce milk with a higher butterfat %).

It is financial efficiency that really counts and this means that, as concentrate (corn and soya) prices increase, we should be trying to make the most of cheaper high fibre feeds – especially forages.

	Ration A	Ration B
Theoretical yield (litres)	32.0	32.0
Total DMI (kg)	19.4	21.2
FCE	1.65	1.51
Feed cost (€ cent per litre) *	14.94	13.27
Ingredients (kg fresh weight)		
Grass silage	5.0	15.0
Corn silage	22.0	25.0
Corn meal	3.6	
High moisture corn	2.0	
Wheat		2.0
Barley		2.0
Distillers grains	5.0	3.0
Soybean meal	2.0	0.5
Rapeseed meal		3.0
Protected fat	0.3	
Minerals	0.3	0.3
Energy density (MJ/ kg DM)	13.0	12.0
Crude protein (%)	17.1	17.1
Forage (as % total DM)	41.3	55.4

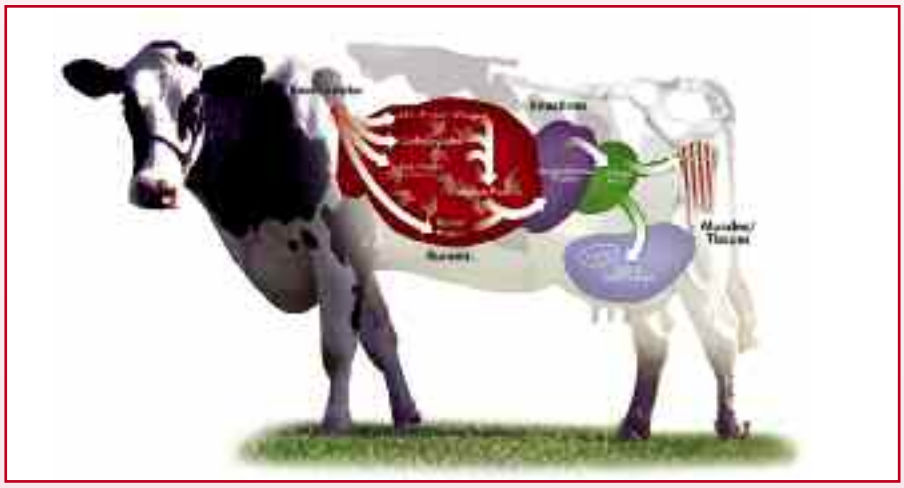
** UK feed costs January 2008 (Farmers Guardian). Euro rate 30th January 2008 (€1.345: £1 Oanda.com).*

Table 1. Two theoretical rations for 32 litres.

Therefore, FCE should not be a goal in its own right but in a given situation and feeding strategy, increase of feed efficiency can be looked at with beneficial impact on production costs. The efficient use of feeds should always be the goal and never more so than in 2008. This means looking at two areas in particular:

- Practical issues of feed management.
- The nutritional efficiency of our cows.

The cow's digestive system.



Feed management

Even though the point of this article is to focus on nutritional efficiency of dairy cows, one cannot ignore the importance of practical feed management. How much silage is 'wasted' through poor fermentation and bunk management and how much of our purchased feeds are spilt, contaminated or otherwise lost during handling? Most industries do stock reconciliations to check up on the level of waste in their operation, but how many dairy farmers ever check the amount of feed actually fed over a month against the amount that went into store? These are questions that need to be answered in a context of elevated feeding costs.

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It is possible to assess nutritional efficiency quite simply. First, it is essential to monitor dry matter intake (DMI) – this should be done for each group of cows and it should be compared with the average milk yield for the group. For non-total mixed ration (TMR) systems, the intake of the bulk feed should be measured, along with the average intake of individually fed feeds. This is essential feedback for the nutritionist and tells the cost of feeding animals on a daily basis.

The weight of feed remaining at the end of the feeding period should be estimated as accurately as possible and should be examined closely – does it consist of waste feed that the animals have rejected?

Second, monitor manure quality and texture regularly. This gives an idea of how much of the diet is actually digested and how much is going straight through the animal. There are various ways of doing this, with various degrees of sophistication, up to, and including sieving systems with guidelines as to what the percentages in each of the sieves means. Sometimes the issue is obvious with whole grains clearly visible or if the manure is far too stiff with a lot of undigested fibre. The first instance signals that grains should be processed and the second is a clear indicator that the rumen is not doing its job (the rumen microbes are not digesting the fibre) so either there is too much present or the fibre digestibility is too low or the rumen bugs are not being fed effectively enough.

Further investigation is key to determining if there are small gritty bits in the manure. These are often not easy to see but can be easily felt. These small particles indicate undigested corn. This phenomenon is very common in areas where high levels of cornmeal are fed and why this (expensive) corn is passing through the cow undigested needs to be addressed.

The reason why FCE can be misleading in ruminants is because they are capable of digesting cheaper high fibre feeds through the action of the microbial population of the rumen. Nutritionist and dairy farmers alike should be obsessed with ways of making the rumen more efficient and if feed prices continue to rise, 2008 could well be considered 'The Year of the Rumen'. It should be the year in which we become obsessed with ways of making the microbial population more effective and more efficient.

Enhancing rumen digestion

There are many ways in which ruminal digestion can be enhanced, ranging from the physical (sufficient fibre of the correct length to form an effective rumen mat). However, enhancing rumen digestion cannot be done without getting a highly active population of rumen micro-organisms to increase the overall effectiveness of rumen fermentation.

Rumen microbes are live organisms and their growth is dependant on how they are fed and the environment in which they are working.

Therefore, nutritional strategies that provide a stable rumen environment are vital. Rumen pH in particular is extremely important in maintaining an active rumen microbial population and especially the fibre degrader rumen microbes as those are extremely pH sensitive. A large part of rumen pH control is linked to ration balance and structure, but in a given situation, it may be improved by the use of live yeasts.

Table 2. Diet composition in Optigen trial (HAUC, UK, 2007).

	Control (kg DM/d)	Optigen II (kg DM/d)
Grass silage	5.84	5.84
Maize silage	5.84	6.78
Wheat	3.13	3.13
Sugar beet pulp	3.13	3.13
Rapeseed meal	1.98	1.46
Soybean meal	1.98	1.46
Optigen II	0	0.10
Vitamins/minerals	0.10	0.10
Total	22	22
Predicted analysis		
ME (MJ/kg DM)	11.9	11.8
Crude protein (g/kg DM)	176	171
Starch (g/kg DM)	176	194
NDF (g/kg DM)	332	344

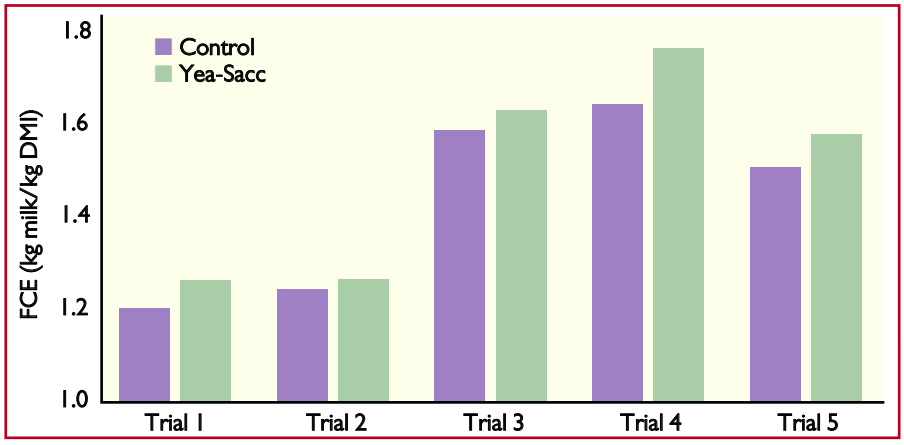

Fig. 1. Synthesis of Yea-Sacc[1026] effect on FCE in European trials. Trials: 1. Saade, France, 2003. 2. Formigoni, Italy, 2004. 3. Sinclair, UK, 2005. 4. Steingass, Germany, 2006. 5. Mulligan, Ireland, 2007.

Studies conducted with Alltech Inc's Yea-Sacc[1026] have demonstrated that it stimulates lactic acid utilising microbes and inhibits the activity of lactic acid producers. This helps to control the rumen pH, maintaining it at the optimum level. In a recent experiment, the average rumen pH increase was 0.17 unit pH and the cows fed with Yea-Sacc[1026] had only 11.1% of their rumen pH below the threshold of 6.2, while it was 26.2% for control animals.

Optimisation of the fibre degradation as fibre digesting bacteria activity is dramatically decreased in case of low rumen pH. This means that the same diet can release more energy to the cow, simply because of a more favourable rumen environment.

Several other studies carried out with Yea-Sacc[1026] have shown an average increase in FCE by 4.8% on FCE (Fig. 1).

Meeting the rumen's needs

In order to grow and function, rumen micro-organisms require a continuous, consistent supply of degradable nitrogen sources, matched to the rate of release of fermentable energy.

In high yielding cows, with a fast rumen turnover, it is often difficult to supply enough degradable nitrogen using conventional proteins (containing both degradable and rumen by-pass proteins) without over-supplying total protein. This is both expensive and environmentally problematic. Since fibre digesting bacteria can use non protein nitrogen (NPN) as a food source and since we are trying to utilise more fibrous materials to compensate for higher feed prices, it would seem to be logical to explore this area.

Alltech's Optigen II is a concentrated NPN source which releases nitrogen at a rate very close to that of soya without any of the immediately soluble nitrogen which is a problem with materials like urea.

Some 100-120g of Optigen II can replace the degradable nitrogen supplied by 1kg of soybean meal leaving space for forage or other cheaper ingredients to be incorporated in the ration.

It is a tool which, when used correctly, enables nutritionists to meet the needs of the rumen microbial population more effectively and more efficiently, resulting in increased microbial growth, increased fibre digestion and increased efficiency of rumen nitrogen capture.

This was recently demonstrated in a study carried out at Harper Adams University, UK. Two nutritional strategies carried out in a rumen simulator fermenter system compared the effects on rumen fermentation parameters (Table 2). Optigen II inclusion resulted in an increased microbial growth by 11% together with a significant increase in both organic matter and fibre digestibility. Elevated volatile fatty acid (VFA) concentrations were also recorded as a result of a more intense microbial activity (Table 3).

As feed costs rise, dairy farmers must turn to the rumen for a profitable solution. The dairy sector must utilise the unique characteristics of the ruminant. Chasing high FCE with high corn diets will be too expensive but efficient use of lower cost high fibre materials, using products such as Yea-Sacc[1026] and Optigen II, will mean that 2008 will indeed be the 'year of efficiency'. ■

Table 3. Fermentation results obtained with or without Optigen II (HAUC, UK, 2007).

	Control	Optigen II	P-value
pH	6.21	6.16	NS
Ammonia-N (mg/l)	203	232	0.058
Total VFA (mmol/l)	80.3	86.9	NS
OM digestibility (g/g)	0.37	0.49	0.103
Fibre digestibility (g/g)	0.45	0.57	0.046
Microbial-N output (g/g)	0.35	0.39	NS