Feed efficiency – the key to fine tuning dairy herd management

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With narrowing margins from dairy production, feed intake by milking cows should be optimised and not simply maximised. The amount of milk produced for each kilogram of feed is the crucial factor that can increase margins as well as reduce pollution potential from manure.

Trials also emphasise the possibility of optimising dry matter intake by dairy and beef cattle through dietary supplementation with plant essential oils.

Dairy farmers face constantly changing feed grain and concentrate prices that continually vary milk production costs. The situation is made even more uncertain by producer prices for milk that have also become more volatile and often considerably lower in real terms. Tight cost management is crucial in such an environment.

Beef, pig and poultry producers have a comparatively straightforward measure of their feeding efficiency through simple weight gain for kilograms of dry matter fed.

Mainly because of the comparatively complicated dietary requirements of lactating cows, this measure has not been widely used in milk production. Other factors are more commonly used for benchmarking milk production economics: income over feed cost or cost of producing a kg of milk, for example. But such measures fail to convey precisely how much milk a kilogram of feed is producing.

This is the role of the factor feed efficiency (FE) in dairying and, alongside daily liveweight gain's records, increasingly in beef production too.

Basically, FE involves a very simple formula: dry matter intake against milk produced. The result gives a key benchmarking figure and has, in a modern efficient dairy herd, been calculated by leading researchers in this sector such as Professor Michael Hutjens, University of Illinois as between 1.4 and 1.9kg milk per kg of dry matter consumed.

Professor Hutjens famously summed up the FE calculation as allowing the optimising of feed intake instead of just maximising it.

Precision management

Applying FE brings a new precision to herd management – and helps the environment too. If a herd averages 38kg milk per cow per day with mean daily consumption per cow of 26kg dry matter, the FE might be around 1.4, i.e. 1.4kg milk for every kg of dry matter intake. Another herd produces the same milk but needs only 22kg of dry matter intake per cow, making an FE of 1.6.

At a similar price per feed unit not only is milk being produced much cheaper in the second herd, but the amount of manure being produced is less and that manure has less nutrients in it.

Such advantages are increasingly important in many parts of Europe now. In the Netherlands, for example, strict nitrogen and phosphate limits per hectare mean that dairy farmers often have to pay to have their herd manure transported long distances and spread on crop raising farms.

Making FE even more efficient as a herd management tool is the fact that the figure reflects even the smallest impact of every change in feed or other management inputs.

One of many problems with conventional maximising of dairy cow dry matter intake is that milk production from (very high dry matter?) the last intake is subject to diminishing returns. The cow's digestion system can also become overloaded – especially the rumen flora – and this not only leads to falling milk production but a series of other health problems including decreasing fertility and even laminitis and other foot and leg diseases.

Special software helps

While dairy herd management on the basis of feed efficiency figures helps to avoid going down that road, the calculations involved in identifying FE can be extremely complicated. Ideally needed for the FE figure is not only actual feed intake in terms of dry matter (and this requires accurate assessment of feed rejected by the cow), but also facts on which lactation, lactation stage, daily yield with fat and protein content, body score, liveweight, the ambient temperature of the barn and surrounds – even the distance the animal might be walking from pasture to parlour and back again each day.

Of course there are now software programs such as FeedAd that can quickly calculate your herd FE – and more are on their way – but all these many variables have first still to be collected and assessed.

This is because all the factors affecting the final FE figure must be applied so that the final figure is a standardised one that can be used in comparisons between herds or benchmarking.

But despite the complications, FE calculations can be made directly on the farm and here is an example of some of the factors involved from work done at the University of Illinois. First of all, a rough estimate for the herd can be arrived at by comparing records of milk sold per day (fat corrected to 3.5%) with total estimated dry matter intake.

Rejected feed can be calculated by estimating the percentage of silage left in the troughs and calculating waste in kg from that.

Days in milk are important in the calcula-

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Table 1. Benchmark feed efficiency (FE) values through the herd (Professor Michael Hutjens, University of Illinois, USA).

Group	Days in milk	Milk produced from 1kg feed dry matter (FE)
All cows	150-225	1.4-1.6
First lactation	< 90	1.5-1.7
First lactation	> 200	1.2-1.4
Second lactation onwards	< 90	1.6-1.8
Second lactation onwards	> 200	1.3-1.5
Newly calved cows	< 21	1.3-1.6
Problem cows/herds	150-200	< 1.3

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tion. For instance trials by Agri-King and the University of Minnesota showed average FE was 1.56 through the lactation, but with the figure as high as 1.8 in the first 60 days, 1.5-1.6 by around 150 days and 1.4 after 240 days. The differences reflect the cows 'milking off their backs' in early lactation and losing bodyweight, the FE lowering later with cows diverting more dry matter intake to bodyweight and growth (with heifers) and also supporting the new calf.

Health problem warning

FE can be a very useful tool in herd health management because a markedly high figure early on could mean too much bodyweight is being put into milk production and ketosis can develop, while a very low FE in the first weeks could be a warning of acidosis or other problems. Of course weighing cows is not always possible on a busy dairy farm and so body condition scoring can be used quite accurately as an indicator for feed adjustments, reductions when condition increases rapidly in late lactation, for example.

There is also the daily walk to the pasture and back to be considered if the cows are kept outside. This factor has been estimated in US trials to bring an extra maintenance requirement equivalent to around 310g milk for every 100 metres.

Other factors coming into the FE calculation include rumen acidosis, protein type and level in feed, any supplements supplied and the feed fibre level. In the last instance, US Journal of Dairy Science figures indicate that increased neutral detergent fibre (NDF) content in feed dry matter can cause FE to decline.

Then, of course, we have the breeding of the animals to consider. The Agri-King work indicates that genetics may affect FE because it is breeding that determines nutrient use in the animal for liveweight gain, milk production, maintenance or other metabolic functions.

British research in 1986 (Gibson) compared Friesians and Jerseys for efficiency in converting feed into milk. Even though the Friesians produced more milk they ate 22% more feed than the pure Jerseys. In the end, there was no difference in feed efficiency between the breeds.

What was discovered was that the high yielders in both breeds were more efficient in converting feed to milk than low production genetic lines, although the high producers lost more bodyweight during lactation.

An aid to further improvement of performance in dairy and beef cattle has been found through supplementation of rations with essential oils.

These have proved over the years to increase cattle performance through modulation of rumen fermentation. A trial with 30 Holstein cows at the University of Delaware (L. Kung jnr., et al) had half the cows fed a TMR with plant essential oils added (1.2g/cow/day over nine weeks).

Cows with diets supplemented with a commercial essential oils product (Crina Ruminants) ate 1.2kg more feed dry matter per day and produced 2.7kg more fat corrected milk than cows fed the control diet.

Unaffected in both groups were the percentages of milk fat and protein, somatic cell counts, and milk urea nitrogen.

Although overall FE did not change, the additional milk in the Crina group was produced very efficiently (2.7kg/1.2kg = 2.25).

Body weight and body condition also did not change in the cows fed Crina Ruminants. Testing for essential oils effect in rumen fermentation in vitro, the researchers at Delaware found, after 12 hours incubation, that addition of essential oils had no effect on the concentration of total volatile fatty acids (VFA) compared with control.

However, molar proportions of acetic, butyric and valeric acids were decreased and propionic acid was increased, possibly offering improved fermentation conditions in the rumen.

Crina Ruminants is a defined and patented blend of natural and natural-identical volatile, aromatic compounds including thymol, eugenol, vanillin and limonene on an organic carrier. These ingredients have been shown to have a selective effect on microbial organisms including the inhibition of development of less desirable rumen flora and the increase of rumen pH.

But the results were a little different in another trial, this time conducted with 40 Holstein cows by the Department of Dairy Science at the University of Wisconsin, Madison (M. D. Tassoul and R. D. Shaver).

The researchers here found that the Crina Ruminants plant essential oils did not actually increase milk yields when fed as a supplement in early lactation.

Instead, the Crina Ruminants fed cattle ate less ration without any negative effect on body score, liveweight or milk yield. In other words, FE was improved in this case by supplementing the diet with plant essential oils.

Yields stay stable

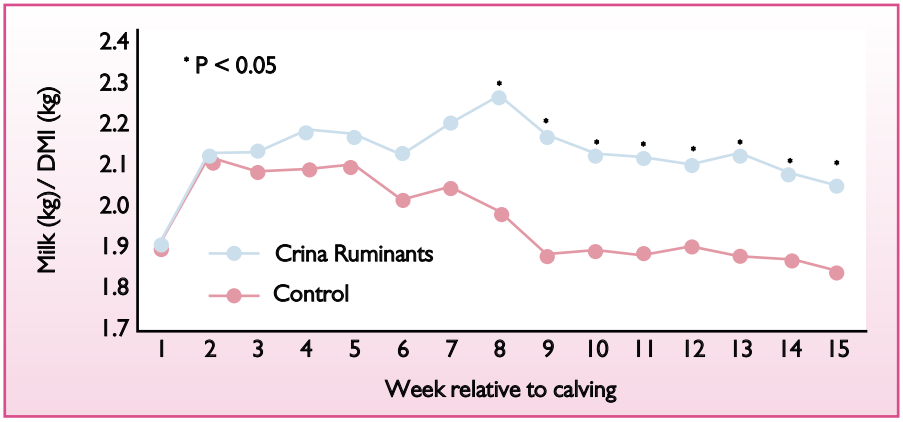
In more detail, the cows were each fed 1.5g per day of the plant essential oils product in the same TMR fed to the control cows without supplement. Supplementation started three weeks before expected calving date and continued for 15 weeks into the lactation. Milk yield for both groups averaged 48kg/day over the trial.

Before calving there was no difference recorded between the two groups in feed consumption and this indicates that there was no difference in acceptance of the feed between the two groups, through palatability for example. But, over the 15 weeks of the trial, the cows on rations supplemented with Crina Ruminants had lower dry matter intake than the control – an average of 22.7kg/day compared with 24.5kg/day.

At the same time the supplemented cows' FE improved in comparison to the one of the non-supplemented cows and the difference became significant from the eighth week onwards (see Fig. 1).

Overall, a significant trend was observed in this trial for the plant essential oils group ($P > 0.10$) of increased feed efficiency (2.15 vs. 1.99), without any change in body condition scores and in plasma non-esterified fatty acids' (NEFA) content.

Fig. 1. Weekly feed efficiency (kg of milk/kg of DMI) least squares means for cows fed control (red) and essential oil (blue) supplemented TMR during 15 weeks (Professor Randy Shaver, University of Wisconsin, USA).



Conclusion

Concentrating on feed efficiency (FE) with beef cattle, where the target may be simply that of weight gain and final carcase weight, is relatively straightforward and can also offer substantial gains as a management aid. With dairy cattle the situation is much more complicated; depending on stage of lactation and other factors.

But identifying FE in this sector is just as important for optimum exploitation of dry matter intake and therefore better margins in times of high feed prices and low milk returns. For further improvement of beef and milk production margins, and often of FE too, supplementation of cattle rations with plant essential oils has shown great promise in a series of trials. ■