# The key to profit – reformulating to get more from your herd's forage

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If you ask a dairy nutritionist which part of the ration he would like to increase in a dairy cow diet if he could, there is a fair chance that he will say 'energy'. This makes sense, as energy deficit is unavoidable in early lactation cows, even though it has a direct and negative impact on further reproductive performances and immunity.

Now, if you ask him why he is simply not adding more, he will probably tell you that he can not add more grains or other energy sources in the diet without reducing forage supply, which would ultimately lead to a serious acidosis risk.

This is really the dairy nutritionist's challenge: provide the nutrients the dairy cow needs for production, health and reproduction but, at the same time, ensure the diet provides enough fibre structure to stimulate rumination and secure rumen function.

In a nutshell, this means a lot of grains or concentrates and large quantities of forage, which, unfortunately, are not as energy and protein dense as concentrates.

These have always been conflicting goals and this is the role of nutritionist: to decide where to put the limit on forage intake and stay on the safe side with regards to acidosis.

***Manure screens from the control diet.***

***Manure screens from the Optigen diet.***

The challenge of bringing more forage while maintaining the same nutrient density has recently received new attention and a new product has been developed by Alltech that aids with solving this challenge. The product, Optigen, is a controlled release urea source, with a rumen degradation curve that has been shown to be very similar to vegetal protein sources, such as soybean meal. As it is a highly concentrated source of nitrogen (41% nitrogen 256% equivalent protein), 100g brings an amount of protein equivalent to 800g of soybean meal and still maintains similar degradation patterns. This opens up new rationing possibilities for nutritionists as Optigen inclusion in dairy diets frees some ingestion capacity that can then be used for additional forages.

Having more forage in the diet is obviously beneficial for rumen function because of the diet structure, but the fibre fraction has still to be fermented in the rumen so that its nutritive value benefits the dairy cow.

One of the most variable fractions in forage for digestibility is fibre as this may vary between 40% for very poor quality forages and up to 85% for the better ones.

These variations are obviously linked to forage maturity and associated fibre type (NDF, ADF and ADL) but rumen microflora activity also plays a significant role.

One influencing parameter is the amount of protein available for the rumen bacteria's

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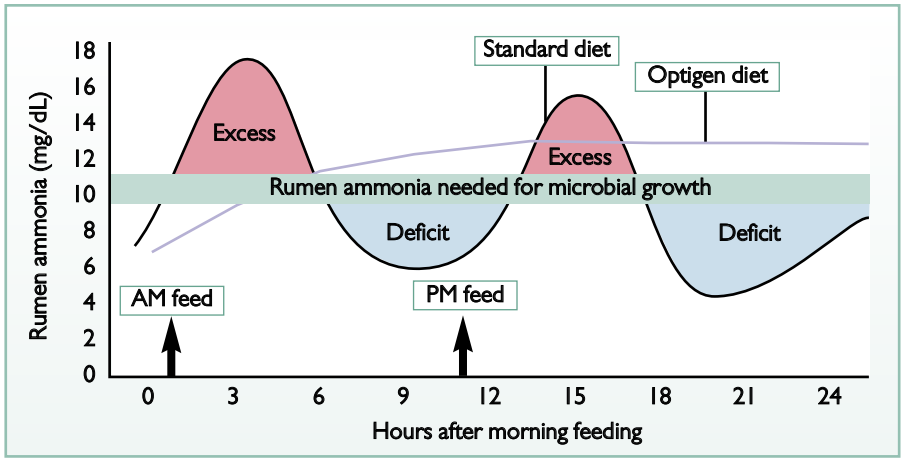
***Fig. 1. Rumen ammonia concentration after ingestion: ammonia release from standard diet (urea) or Optigen (Adapted from Lykos et al., 1997).***



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own growth. In particular, cellulolytic bacteria have a specific and exclusive requirement for NPN (non-protein nitrogen) or ammonia sources (CPM-Dairy). It is, therefore, crucial to supply the bacteria with these nitrogen sources to ensure appropriate feeding so that fibre is efficiently fermented.

A regular supply is also necessary as rumen bacteria can capture only a maximal amount of nitrogen per unit of time. Bacteria can deal with excess but not with nutrient deficiency: in case of excess, surplus nitrogen will be metabolised into urea, but in the case of deficiency, cellulolytic bacteria will simply be short of nitrogen sources, which, in turn, can momentarily decrease their growth efficiency.

Feeding alternative nitrogen sources, such as Optigen can thus ensure a more constant ammonia level in the rumen (Fig. 1).

In a trial carried out at Harper Adams University College in the UK, where a higher level of corn silage was fed to lactating cows via Optigen inclusion as partial replacement of soybean meal and rapeseed meal, nitrogen and energy efficiencies were monitored.

Optigen-fed cows had a higher nitrogen efficiency, which reflects the fact that rumen bacteria captured nitrogen from Optigen more efficiently compared with the control as it is released very steadily over time.

Additionally, in a separate experiment carried out at Universidad federal de Lavras in Brazil, researchers have looked at the effect of nitrogen source on plasma urea nitrogen (PUN) average levels but also time spent above the toxic limit value of 21mg/dL. While daily average levels were not significantly different between treatments, time with PUN over 21mg/dL was increased from 41 and 46 minutes for Optigen and control diets (vegetal protein sources), respectively and to 105 minutes for a diet containing urea.

| | Control | Optigen | P-value |
|---|---|---|---|
| **Nitrogen** | | | |
| Intake (g/d) | 619 | 581 | <0.001 |
| Nitrogen milk output (g/d) | 165 | 162 | 0.427 |
| Nitrogen efficiency | 0.267 | 0.281 | 0.002 |
| **Energy** | | | |
| ME intake (MJ/d) | 275 | 264 | 0.067 |
| ME output (MJ/d) | 251 | 262 | 0.155 |
| ME efficiency | 0.914 | 0.997 | <0.001 |

***Table 1. Nitrogen and energy efficiencies from Optigen and control diets fed to cows.***

In the UK study, along with the higher N efficiency, energy efficiency was also significantly improved. Indeed, this figure almost reached the value of one, meaning that energy intake almost integrally transferred into milk production and body weight gain, thus clearly showing ideal rumen fermentation conditions (Table 1).

This effect is also clearly visible at farm level: in a large scale farm trial carried out in Poland in 2009 under the supervision of researchers from Krakow University, introduction of Optigen in a similar manner to that previously described resulted in a 1.6kg/day milk response, without any change in body condition score.

When looking at undigested particles remaining in the manure, there was a clear decrease in large particles in favour of the smaller particles (see photos for control and Optigen respectively).

Fewer undigested particles obviously reflect more energy released from the diet, especially from the forage part, which results in the practical result of additional milk production or body weight gain according to energy partitioning and physiological stage.

The possibility to increase nitrogen efficiency through the use of Optigen pushes protein nutrition borders further: if nitrogen from Optigen is more efficiently captured by rumen bacteria and transformed into additional microbial biomass, why not use this characteristic to decrease total dietary nitrogen supply?

This could be applied in the case of resource scarcity or simply to lower nitrogen excretion and thus environmental pollution. Researchers from PennState University have looked at decreasing crude protein supply from 16 to 15,5% while increasing forage quantity fed to cows through Optigen introduction.

Optigen partially replaced heat treated soybean meal and canola meal. This resulted in an increased nitrogen efficiency (from 28.8 to 30.8%, respectively, in control and Optigen group) together with a higher milk production in the Optigen group (41.6 vs. 40.5kg/day) while body condition score was unchanged.

This resulted in an elevated Income Over Feed Cost by €0.42/day (European average diets and milk prices), thus showing that real innovations can make milk performances, environmental protection and financial results compatible.

In conclusion, innovative nitrogen sources like Optigen can help solve the dairy cow nutritionist's daily challenge: producing healthier diets through higher forage supply, without reducing nutrient density and, ultimately, performance. It also opens new avenues for dairy farmers to help them attain higher nitrogen efficiencies in a climate where, in the near future, public policies are likely to demand them. ■