Nutritional strategies to reduce nitrogen excretion

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The sustainability of the dairy industry is dependent on increased productivity and improved efficiency. Efficiency is determined by cost per unit of product – in this case per litre of milk. Improvement in efficiency of utilisation of nutrients, reproduction and longevity in high yielding dairy cows are key drivers of overall profitability and sustainability.

In addition to the production challenge, current economic variables are also driving dairy farmers to look more closely at production costs.

As feed prices currently represent around 60% of the total cost of milk production, dairy farmers need to ensure they include feed efficiency monitoring as a key parameter in their management strategy. At the same time, there is an ever increasing requirement to reduce the impact of ruminant livestock on the environment and one of the key components of this impact is nitrogen excretion.

Nitrogen

Ruminant animals are susceptible to poor nitrogen use efficiency due to the manner in which soluble and excess nitrogen is dealt with – conversion into ammonia then urea if not used by rumen microbes. In the case of excess nitrogen, the vast majority of urea will be excreted, which is obviously detrimental for the environment but also has an energetic cost to the animal due to the detoxification of ammonia into urea prior to excretion – this situation is exacerbated when animals are overfed crude protein in order to try to meet amino acid demands for the desired milk yield.

The energy required to excrete excess nitrogen can be the equivalent of up to 2kg of milk (Fig.1) and also leads to body condition loss, increased blood and milk urea levels and, subsequently, issues with reproductive performance.

Traditionally, the solution has been to decrease the rumen degradability of dietary protein and increase the supply of what is termed by-pass protein and supply a balance of key essential amino acids directly to the small intestine with varying success with respect to nitrogen use efficiency. Microbial protein is the most efficient and cost effective protein source for ruminant animals and promoting protein utilisation in the rumen by supporting the nitrogen requirements of all rumen microflora is a key component of improving nitrogen use efficiency.

Rumen bacteria have varying requirements for protein sources. Cellulolytic bacteria have a requirement for a constant and adequate supply of non-protein nitrogen (NPN), while amylolytic bacteria rely on highly nutritional value protein sources for their amino acid requirements.

Recent research carried out by Alltech has led to the development of a unique protein source that addresses the challenge of efficient protein nutrition for dairy cows. Rumagen is unique in that it combines a sustained-release NPN source with a high nutritional value protein source.

The sustained-release element ensures a steady supply of NPN to the rumen cellulolytic microflora, while the high nutritional value source is designed to provide protein for amylolytic bacteria making it the ideal protein source for the whole rumen environment.

Fermentation is increased in the liquid phase of the rumen and a by-pass component supplies essential amino acids directly to the small intestine.

Rumagen offers the opportunity to reduce the need to over feed dietary protein by providing a suitable protein that optimises nitrogen utilisation in the rumen. It typically allows dairy nutritionists to lower dietary crude protein by up to 2% of dry matter and reformulate more balanced diets and has shown to increase milk production by approximately two litres a day (Table 1).

This increase in milk yield represents an energy sparing effect from a reduction in the amount of ammonia requiring detoxification, while improving nitrogen utilisation efficiency (Table 2) for the desired milk production.

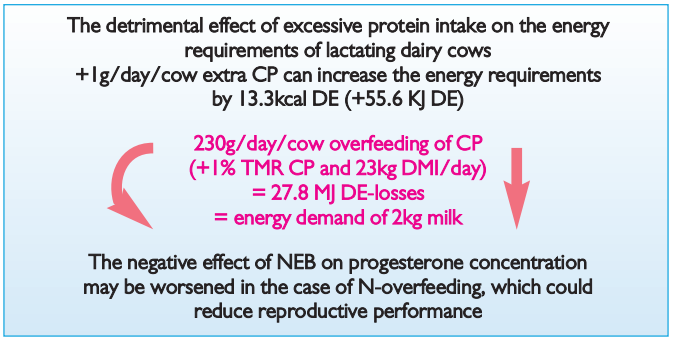

Fig. 1. The energetic cost of detoxification of excess nitrogen in dairy cows (Butler, 1998; Tyrrell et al, 1970; NRC, 1989).

Table 1. Overview of farm results with Rumagen inclusion.

Country	No. of cows	Days in milk	Duration (days)	Dietary crude protein (% of DM)	Milk response kg/day	IOFC * €c/d
Italy	100	200	40	16.16/ 15.7	+1.2	+0.32
Hungary	120	125	90	17.4/16.6	+1.1	+0.33
Hungary	210		80	17.8/16.2	+2.5	+1.1
Latvia	400		60		+2.4	+0.86
Switzerland	43	139	30	=	+2.6	+0.80
Average					+1.96	+0.68

*IOFC: income over feed cost

	Control	Rumagen
DMI (kg/d)	22.4	22.4
CP (%)	16.7	15.7
Milk yield (kg/d)	31.8	34.1
Protein (%)	3.47	3.45
Casein (%)	2.79	2.85
Milk N efficiency (%)	29.5	33.5

Table 2. Effect of dietary inclusion of Rumagen on milk production and nitrogen efficiency in dairy cows.

In a recent commercial study in France, 250g of Rumagen were reformulated into the diet of 130 dairy cows for 15 weeks.

An additional 1.6 litres of energy- and fat-corrected milk (EFCM), as well as an increase in milk fat of 1.9g/l and 2.1g/l in milk protein resulted in additional margin of €0.20 per head per day. A concomitant benefit was a 20% reduction in undigested fibre as demonstrated by manure sieve analysis. Again, this demonstrates a more efficient rumen function leading to greater utilisation of the diet.

Optimum efficiency can be achieved by focusing on the dairy cow's ability to utilise microbial biomass as a nutrient supply.

By formulating dairy diets to optimise protein supply and maximise microbial protein synthesis it is possible to increase the utilisation of dietary nutrients, improve nitrogen use efficiency and promote sustainable productivity. ■