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nutriopt

A MAJOR DEVELOPMENT IN DAIRY DIETS

By Dr John Allen and Dr Liz Homer, Trouw Nutrition GB

trouw nutrition
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The new NutriOpt dairy rationing system will be widely available on dairy farms this winter and constitutes the biggest development seen in our understanding and application of dairy cow feeding for over 20 years.

There are two key areas which have helped define the advances in dairy cow productivity over the last 50 years, contributing to increases in yield and productivity which, to many, were unimaginable.

The first is the advances in genetic technologies. Better indices, more rigorous selection and the introduction of techniques such as semen sorting, embryo transfer and genomics have all helped farmers breed more potentially productive cows.

The second has been the evolution of more effective dairy nutrition models which have helped us to feed cows with increasing precision to allow them to realise their genetic potential. We have progressed through hay and starch equivalents to the ME system which, although introduced in the 1970s, still largely underpins our current feeding approaches.

Since then we have seen incremental developments in both energy and protein feeding systems which together have improved the way cows are fed, based on better understanding of animal requirements and the performance of the digestive system.

The last major revision was the Feed into Milk system which was a significant development but is already over 15 years old. Since then there have been no advances in the systems used to construct efficient and effective dairy cow diets, until the launch of NutriOpt this year.

NutriOpt – new thinking for today's dairy cows

Developed by Trouw Nutrition at the Ruminant Research Centres in Boxmeer, The Netherlands and Guelph, Canada and now extensively validated, NutriOpt is a modular precision-feeding system based on the latest nutritional science, data and technology. The system allows nutritionists to fine-tune feeding strategies with greater accuracy.

Rather than an incremental advance, The NutriOpt Dairy Model allows cows to be fed with greater precision with better focus on rumen stability and general animal health. It is unique in that unlike systems currently in use, it fully integrates predictions of energy and protein supply within the rationing model which is essential given the considerable interdependencies of energy and protein.

Utilisation of all nutrients in raw materials is taken into account; considering fermentation in the rumen, digestion in the small intestine and fermentation in the large intestine, to provide a true nutritional feeding value of each feed to the cow. Furthermore, supply of specific nutrients can be calculated which provides further accuracy when formulating for yield and milk components.

The model itself comprises three principal elements:

A rumen model which considers the balance of carbohydrate and protein fermentation, including rate and extent. New parameters improve the ability to predict the effect of ingredients on rumen health

A cow model which predicts the end products of digestion which are actually then utilised by the cow

A dynamic rationing model which can more accurately build effective rations as it is based on what actually happens in the cow

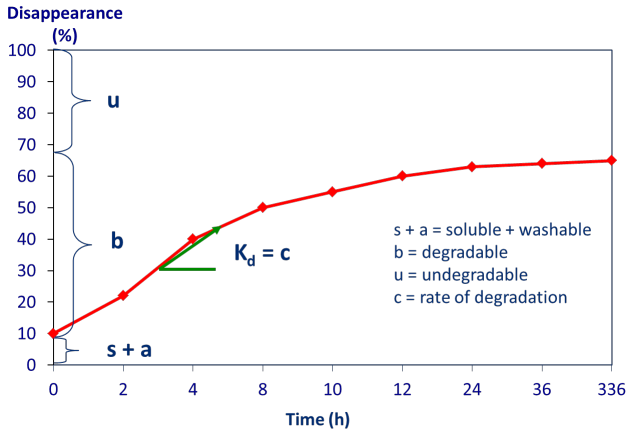
In very simple terms the model is based on a better understanding of what is in a feed, how it is degraded in the rumen and the nutritional value the feed provides.

Research has focused on developing a more complete understanding of the degradability of dry matter, crude protein, starch, sugars and NDF in individual feeds and forages and how these behave in the rumen. It is important to know the soluble, degradable and undegradable fractions of nutrients and, equally importantly the rate of degradation in the rumen. This is a fundamental advance on current systems.

In the system, fermentable carbohydrates and proteins are split in the model into rapidly fermentable (fermented in under two hours after food is eaten) and slowly fermentable (fermented in over two hours after the food is eaten), which added together equals totally fermentable carbohydrates and proteins (Figure 1).

Figure 1. Degradability of nutrients in the rumen

determining soluble, degradable and undegradable proportions and the rate of degradation.



It is important to know rates of rumen fermentation so we can balance the rapidly fermentable carbohydrates and proteins and the total fermentable carbohydrates and proteins so that all of the rumen

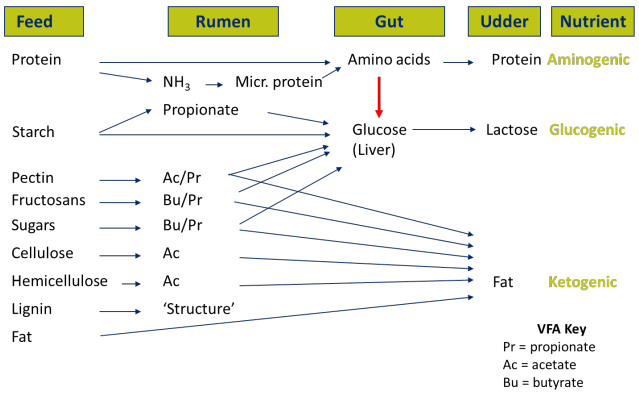
microbes can be satisfied with a continuous supply of both energy and protein.

Rumen fermentation produces different levels of volatile fatty acids (VFAs), principally propionate, acetate and butyrate. They all contribute to overall energy supply but yield a different energy level, so by understanding the amount produced it is possible to start to better appreciate the energy actually available for the cow to utilise.

The system also better accounts for the roles carried out by specific energy sources and the impact on production, defining energy sources as glucogenic, aminogenic and ketogenic (Figure 2).

Figure 2. NutriOpt Dairy Model schematic diagram

how nutrients in raw materials are utilised in the rumen and gut and which specific nutrients can be utilised in the udder



A better understanding of rumen dynamics and how feeds behave also allows a better appreciation of factors influencing rumen health. Rates and extent of rumen fermentation result in alterations to rumen pH. Knowing this allows for more precise determination of acidosis risk.

Fermentation of proteins and carbohydrates, not forgetting fermentation products of silages e.g. lactic acid all contribute to the acid load on the rumen and acidosis risk.

At the same time, fermentable carbohydrates, NDF and physically effective NDF, contribute to the fibre index in the rumen which plays a vital role in rumen buffering.

The NutriOpt system calculates both acid load and fibre index which should be balanced for optimal rumen function.

NutriOpt in practice

The greater information gathered on feeds and how they are digested means NutriOpt can produce more accurate rations which better predict how feeds will perform and subsequently be utilised in the cow. To do this, the system uses a number of new parameters which farmers and nutritionists will have to learn to become familiar with.

The first, and to farmers, most significant change is that the system does not use Metabolisable Energy (ME), a term used since the mid-1970s and something everyone has grown up with.

ME is an empirical assessment of energy availability and has several flaws. Because NutriOpt measures the end products of digestion available to the cow, it can more precisely determine energy supply from the various sources that contribute to the total. It can take account of the energy supplied by VFAs produced from rumen fermentation, energy produced from enzymatic digestion of feeds such as starch in the small intestine and the 10-15% of total energy which is supplied by VFA production in the large intestine. In addition to energy supply from VFAs, glucose, fatty acids and amino acids, it also allows for the contribution of lactic acid from preserved forages.

The result is that NutriOpt defines energy requirements and supply using the term Dynamic Energy (DyNE) which is effectively a net energy system based on the end products of digestion. Principles of diet construction remain the same – calculate the energy requirements and then devise a ration to satisfy them. However, instead of using 65MJME/day for maintenance and 5.3MJME/litre, requirements will be calculated on 37MJDyNE for maintenance and 3.1MJ/litre.

Protein is calculated using the term NutriOpt Digestible Intestinal Protein (NDIP) which is the sum of microbial protein yield formed in the rumen and any bypass protein absorbed in the small intestine. As such it takes account of digested microbial protein, and digested bypass protein to give the supply of metabolically available protein.

Like the current measure of MPE, NDIP is largely focussed on rumen energy supply as the limiting factor in the microbial protein yield and NutriOpt includes measures to allow more accurate balancing of fermentable energy and protein supply in the rumen by looking at both rapidly and total fermentable energy and protein. The new term NutriOpt fermentable energy and protein balance (NFEFB) offers considerable potential to fine tune diets to improve rumen efficiency.

NFEPB is the balance of rapidly fermentable carbohydrates with rapidly fermentable proteins, and balance of totally fermentable carbohydrates and totally fermentable proteins within the rumen. This provides the rumen microbes with a constant supply of energy and protein for optimal microbial protein synthesis. When formulating a diet, a balanced diet will have a NFEFP of 0-200g/day on a total diet basis.

If NFEPB is greater than 200g/day then there is too much rumen fermentable protein, or too little rumen fermentable carbohydrate and the diet will be inefficient, with possible consequences for fertility and the environment.

If NFEPB is negative, less than 0g/day, then there is too much rumen fermentable carbohydrate in the diet, or too little rumen fermentable protein. If NFEPB is below 0g/day in the total diet then NDIP requirements may not be met as there will be insufficient rumen protein (for the supply of rumen energy) and microbial protein synthesis will not be maximised. This will also negatively impact on dry matter intake.

NFEFB will allow quantification of the problem allowing more precise diet-fine tuning.

The model also allows better estimation of the role of fats in the diet. The Rumen Unsaturated Fatty Acid Load (RUFAL) is the sum of the three primary unsaturated fatty acids in a cows diet: oleic acid (C18:1), linoleic acid (C18:2) and linolenic acid (C18:3). If RUFAL level in the total diet exceeds 25 g/kgDM then cows may be at risk of decreased butterfat. RUFAL should largely be considered alongside the Rapidly Fermentable Carbohydrate level and the rumen health parameters acid load and fibre index.

Potential benefits

Any new model must deliver benefits over existing systems, especially if it is asking the industry to radically change its thinking. The NutriOpt model offers three major benefits to farmers as they look to manage costs of production.

Maximising forage utilisation – better knowledge of how forages behave in the rumen, what is absorbed and digested along the whole gastrointestinal tract gives a true reflection of the energy and protein available to the cow for maintenance, health and production. Supplementation can then be cost effectively tailored to complement forage to maximise rumen efficiency and performance.

Optimising rumen health - Balancing acid load and fibre index allows for optimal rumen health and therefore optimal performance and improved health. Reducing the consequential losses from clinical acidosis and SARA will benefit most herds

Manipulate milk yield and milk constituents - We know what nutrients, whether glucogenic, ketogenic and aminogenic, are formed and absorbed along the whole gastrointestinal tract. More accurate prediction of energy supply (DyNE) will help to maximise milk production, whilst the individual components can be manipulated to influence milk quality.

Does it work?

A perfectly reasonable question is how do we know that a research based system will deliver in practice? The NutriOpt model has been, and continues to be the subject of extensive validation using data sets from the UK and wider.

The NutriOpt model is already in effective use in Europe and Canada. Moreover, it has been subject to extensive validation using data from published trials from the UK and around the world in a process known as meta-analysis. 290 diets from 62 peer reviewed papers were 'plugged into' the NutriOpt model and the predicted performance compared with actual performance published in each of the trials. The study showed that the NutriOpt model improved precision of predicting milk production by some 65% compared to conventional rationing systems.

Summary

The NutriOpt system is a totally new approach to feeding dairy cows based on extensive research and validation. It uses new approaches and information on the utilisation of nutrients in raw materials, how feeds are fermented in the rumen and digested in the small intestine or fermented in the large intestine. It is a fully integrated energy and protein system which better models them individually and collectively.

Together this will allow cows to be fed with greater precision, with better focus on rumen stability leading to more cost-effective production and improved animal health.

The NutriOpt system is now widely available to users of Dietcheck and Ultramix and all forages analysed by Trouw Nutrition GB will include the NutriOpt parameters. We are confident that as nutritionists and farmers become familiar with the system they will see the benefits of the new approach, even if they have to change the thinking that has served the industry well for over 40 years.

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