Predicting the nutritive value of dairy cattle rations

Multiple factors impact dairy ration digestion. The primary functions of the rumen are to break down fibre and synthesise microbial protein. Both functions are essential, as much of the energy and protein utilised by the cow comes from the rumen.

by Kamal Mjoun, senior research scientist and Maria Agovino, European ruminant manager, Alltech European Bioscience Centre, Sarney, Summerhill Road, Dunboyne, Co. Meath, Ireland.
alltech.com

Good rumen function will ensure optimal feed intake and digestion, while poor rumen function can negatively impact intake and overall cow performance. Proper ration formulation and understanding how the individual ingredients in the ration work together can help keep the rumen, and your cows, functioning properly.

Feed analyses

In intensive dairy production, feed costs represent up to 60% of the total cost of producing milk. Continuous improvement in dairy efficiency is vital to the success of the dairy enterprise. Reliable and rapid feed analyses are therefore required to accurately assess the availability of energy and nutrients of feeds. Traditional methods to estimate digestibility focus on end-point measurements and do not provide information on the rates of digestion, which are very important in assessing the amount of nutrients available to the animal, nor how the diet will impact on rumen function.

One of the main causes of rumen upset is acidosis (low rumen pH), often caused by high starch rations or feed with small particle size. When there is too much starch, the volatile fatty acids (VFA) can build up and reduce the rumen pH. Rations that are high in fat can impede microbial digestion in the rumen.

Poor quality forage may also negatively impact rumen function, leading to poor fibre digestion and reduced energy availability. Poor fibre digestion due to rumen upset can manifest itself in reduced feed intake and increased amounts of undigested fibre in faeces. Reduced milk fat and laminitis are two of the most common symptoms of subpar rumen function.

Dynamic diagnostic tool

The In Vitro Fermentation Model (IFM) is a diagnostic tool that simulates rumen fermentation and evaluates the nutritive value of total mixed rations in terms of digestibility and end products formation.

The evaluation of complete feeds has the advantage to closely simulate animal feeding and to evaluate the associative effects of ingredients within the ration.

Nutritionists have traditionally relied on nutritional models and feed chemical characteristics to formulate diets for dairy cows. Available nutrition services provide measurements of chemical composition and digestibility.

Yet this information is static and does not provide complete evaluation of nutrient availability. IFM is a more dynamic diagnostic tool that provides for estimation of the kinetics of feed digestion, rather than end-point measurement of digestibility, in addition to other important end products of rumen fermentation.

Microbial activity is measured in terms of microbial biomass, a critical source of digestible protein for the dairy cow, as well as VFA, a critical source of metabolisable energy for the cow. The goal of IFM is to offer nutritionists and producers another way to look at feed evaluation and to propose solutions and strategies to potential issues.

Key parameters and applications

Dietary carbohydrates (sugars, starch and fibre) are the main focus of IFM analysis, as they are extensively fermented in the rumen into VFA, gases and microbial biomass.

The gas produced during fermentation can be used as a proxy to dry or organic matter digestion. The gas curve is fitted to specific mathematical models to get detailed

insight on the dynamics and the balance of the different carbohydrate fractions.

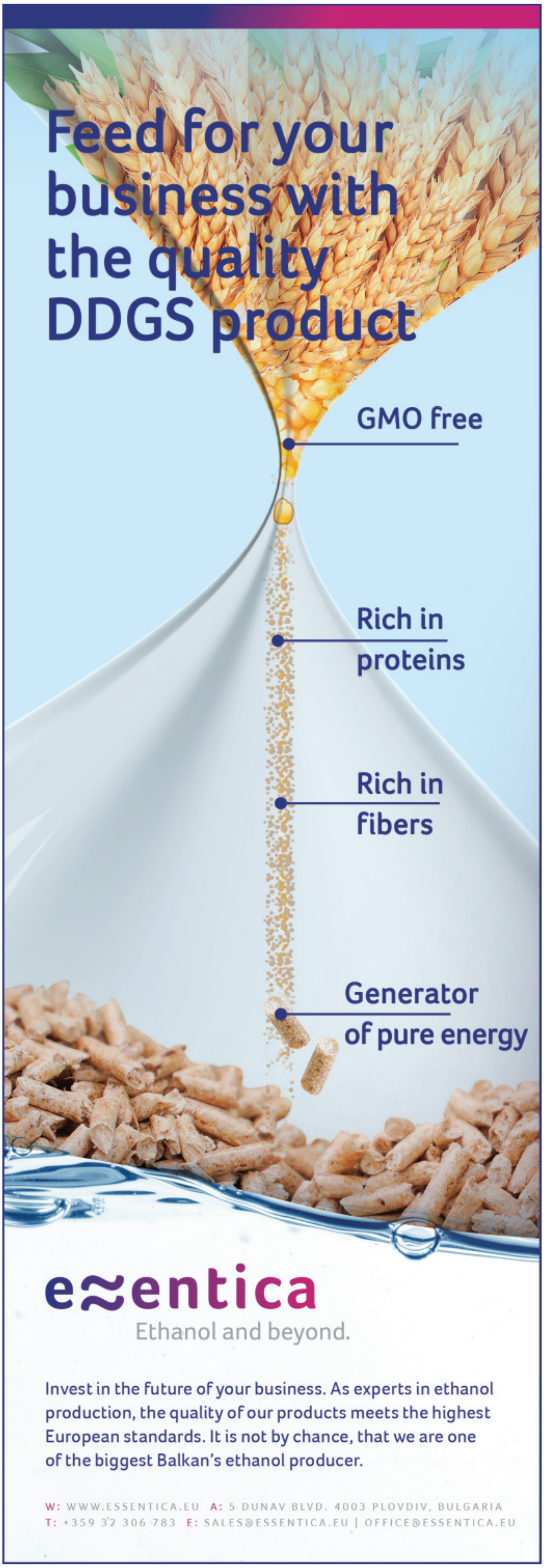
Two major pools are derived: a fast pool that corresponds to rapidly fermented carbohydrates (mainly sugars and organic acids, starch, pectin) and a slow pool gas production that consists of insoluble available fibre or slowly fermented carbohydrates.

The proportion of energy supplied from quickly or slowly degrading carbohydrates depends on the feedstuff. For example, ensiled feeds contain more organic acids; cereal grains contain starch; beet pulp, citrus pulp and soy hulls contain significant amounts of pectins. Grass hay, molasses and beet pulp contain large concentrations of sugars.

The type of nutrient available to rumen microbes will affect the rate of degradation of the fast and slow pools, and their sizes will determine the type of organic acids produced during fermentation and may affect the growth rates of rumen microbes.

The end result will be variable amounts of digestible energy and protein available to the animal. The balance between forages and concentrates (quickly and slowly

Continued on page 31


Feed for your business with the quality DDGS product
GMO free
Rich in proteins
Rich in fibers
Generator of pure energy
essentica
Ethanol and beyond.
Invest in the future of your business. As experts in ethanol production, the quality of our products meets the highest European standards. It is not by chance, that we are one of the biggest Balkan's ethanol producer.
W: WWW.ESSENTICA.EU A: 5 DUNAV BLVD. 4003 PLOVDIV, BULGARIA
T: +359 32 306 783 E: SALES@ESSENTICA.EU | OFFICE@ESSENTICA.EU


南京伟拓药业有限公司
Nanjing Vetop Pharma Co., Ltd
中比合资
伟拓药业
VETOP
Our veterinary medicines are exported to more than 20 countries such as UK,France,Russia,Mongolia etc.
Sino-Belgian joint-venture with reliable quality!
Welcome to send inquiry and visit us in China!
GMP
ISO 9001
ERP
诚信 创新 优质 高效
HONESTY CREATIVITY QUALITY EFFICIENCY
Address:16 Tuanshan East Road, Lishui, Nanjing, China
Tel:86-25-84726053
Website:www.vetop.cn
Email: info@vetop.cn
Skype:jerome_zhou63@hotmail.com
Wechat: jeromezhou63


Positive Action Publications Ltd
Publishers of international magazines in the pig, poultry, dairy, food safety & meat production sectors
FREE Editorial Library
select a magazine
Your personal online technical resource
Our extensive article library allows you to download previous articles from all of our titles
It is fully searchable and available FREE
www.positiveaction.co.uk
The global technical leader

Continued from page 29
degrading carbohydrates) among feedstuffs in a ration is critical to maximise the efficiency of the fermentation. The goal is to maximise production of microbial biomass and VFA, which are important sources of metabolisable energy and protein, and minimise fermentation gases (carbon dioxide and methane) that are considered energy losses to the animal.

Unbalanced pools need to be corrected by making adjustments to the inclusion rates of the individual feeds.

Corrective strategies

IFM uses standard incubation procedures with a rumen fluid and a buffer system to mimic natural rumen fermentation. For each sample, more than 20 parameters indicative of rumen fermentation are generated as well as the nutrient profile-based wet chemistry. Both fermentation parameters and nutrient profile are used to generate detailed reports to address the strengths and weaknesses of rations and ultimately propose strategies to correct these inefficiencies.

Often, reformulation of the ration by changing feeding rates of the existing feedstuffs is sufficient to fix issues. Other times, sourcing other feeds may be required to achieve efficient digestion.

When fine-tuning does not work, the use of enzyme technology and yeast cultures targeting fibre and starch breakdown is another option to improve the overall nutritive value of the feeds.

Most issues relate to the digestion rates of the fast (sugars + starch) and slow (fibre) pools. Samples can have very slow or fast pool rates, indicating a lack of fermentable carbohydrates or the presence of slowly fermenting starch. In the case of slowly fermenting starch, the inclusion of processed corn (steam-flaked, rolled corn or high-moisture corn) may be needed.

On the other hand, fast rates indicate excess sugars or the presence of very fermentable starch. Such cases would present high acidosis risk.

Replacing very quickly degrading carbohydrates (high-moisture corn, barley, etc.) with moderately degrading grains (dry ground corn) will reduce the risk for acidosis, while still providing the cow with readily available energy.

Fig. 1. The InVitro Fermentation Model.

Slow fibre digestion affects feed intake and animal performance and is indicative of poor forage quality. For feeds presenting such issues, sourcing better-quality forages or by-product feeds, such as soy hulls, beet pulp or citrus pulp that are rich in soluble fibre and quick to digest, should correct the problem. When implementing changes for optimal rumen fermentation, it is important to ensure a balanced ration that promotes a healthy functioning rumen.

IFM analysis

More than 1,000 feed samples have been analysed at the Alltech IFM lab since 2012. The evaluation of these samples shows wide differences among dairy diets, reflecting variability in feeding systems, types of ingredients and quality of feeds.

The IFM evaluation is effective in identifying samples with extreme fermentation profiles (values outside normal ranges) that are most likely to present production challenges.

In addition, ranking dairy total mixed ration (TMR) samples according to their level of production can be used to derive an 'ideal' fermentation profile that should maximise dairy performance provided the lactation stage, genetic potential and other management and environmental factors are permissive.

The analyses of relationships between animal performance and the fermentation profile of diets consumed reveal the importance of key fermentation parameters, including the size of the fast pool gas production, rates of digestion of the slow pool (fibre) and starch, total gas production, VFA and microbial biomass in positively affecting the milk production level. In addition, 50-70% of the samples analysed have the mentioned parameters at below-average values for the top 90% of producing herds.

Similarly, more than 20% of those samples are one standard deviation below these key values, pointing out the issue of low-quality feeds. These comparisons suggest there is a significant potential to alter the make-up of dairy feeds for more efficient rumen fermentation and improved milk yield and feed efficiency.

Making the right interpretation

Rumen fermentation is a complex process in which end products of fermentation are produced in proportions that depend primarily on substrate availability and the efficiency of microbial growth.

Digested feed, microbial biomass, VFA and gas production are the end products of fermentation. It is important to simultaneously take into consideration all parameters and not focus on a single metric when making conclusions and potential adjustments to a diet. ■