Digestible fibre is not the whole story when formulating rations

Don't forget about pectins

The term 'digestible fibre' will be familiar to many producers, as will its importance in helping to optimise rumen function and its role as a buffer against the risks of acidosis. But when it comes to achieving the positive effects on rumen fermentation that we traditionally associate with digestible fibre, it's not as straightforward as it seems.

text **Rachael Porter**

Packed with pectin: sugar beet feed has a relatively high pectin content

It's not all about digestible fibre, according to Trident technical manager Michael Marsden: "Put simply, there are other less-well-known feed components called pectins that can have further beneficial effects and must be considered when formulating rations," he explains.

"And from what we know, it appears that these pectins may be another reason why digestible fibre-based feeds often give different responses when fed to livestock."

Pectins are complex carbohydrates found in plant cell walls, with most concentrate feeds typically containing less than 3% in the dry matter.

However, digestible fibre feeds tend to contain much higher levels, and although the analysis is somewhat inconsistent, best estimates put the pectin content of sugar beet feed at 35%, soya hulls at between 24% and 26% and citrus pulp pellets at 15%.

The fraction used to estimate rumen digestible fibre in a feed is known as neutral detergent fibre (NDF). But this fails to measure the very useful and beneficial pectin content of the feed.

"The challenge for producers and nutritionist is that pectins are hard to measure, are rarely listed in the literature, and so end up being ignored during ration formulation," says Dr Marsden. In the feeding and ration formulation systems used in the US, for example, pectins are measured as part of a fraction called neutral detergent soluble carbohydrates (NDSC), which is added to the NDF fraction when calculating overall digestible fibre content (see Figure 1).

"Certain feeds used to supply digestible fibre perform better – in terms of rumen fermentation and animal performance – than their basic UK proximate analysis would suggest. It's the pectins, along with differences between the digestible fibres themselves, that appear to be responsible," he adds.

Table 1: Impact of digestible fibre source on milk production

	maize (starch)	sugar beet feed (digestible fibre)	maize (starch)	citrus pulp (digestible fibre)
dry matter intake (kg/cow/day)	21.6	20.4	21.0	20.4
milk yield (kg/cow/day)	32.3	32.0	35.6	34.7
butterfat (%)	3.64	3.82	3.33	3.38

Adding value

Table 1 shows the results of a pair of trials from the US where a proportion of maize grain (starch) was replaced by digestible fibre energy in the form of either sugar beet feed or citrus pulp.

The trial was set up to demonstrate the value of switching some starchy concentrates to those based on digestible fibre, and as would be expected, butterfat percentage increased in both trials.

More interestingly, not only did the sugar beet feed produce a much greater milk fat response (+0.18% versus +0.05%), but it was also able to maintain milk yield despite having a lower energy content than the maize. In terms of value, the sugar beet feed is clearly adding more to the ration than the citrus pulp.

What's becoming clear is that a large part of this response appears to be due to the pectins, which may be linked to the increased production of acetate (a building block for butterfat production in the udder).

This occurs when sugar beet feed is fermented in the rumen, rather than citrus pulp.

"Pectins play a crucial role in both energy supply and rumen fermentation buffering, yet are very poorly understood," stresses Dr Marsden. "They're part of the carbohydrates available for rumen fermentation – along with sugars, starches and digestible fibre – yet aren't included in any of the measurements we use to determine feed value in this country.

"As soluble carbohydrates, pectins are rapidly fermentable in the rumen, much like starch and sugars," he adds.

"But unlike starch and sugars, which break down to produce mainly propionate (starch) or butyrate (sugars), the fermentation of pectins in the rumen produces acetate.

"It's the same acetate that's produced from the

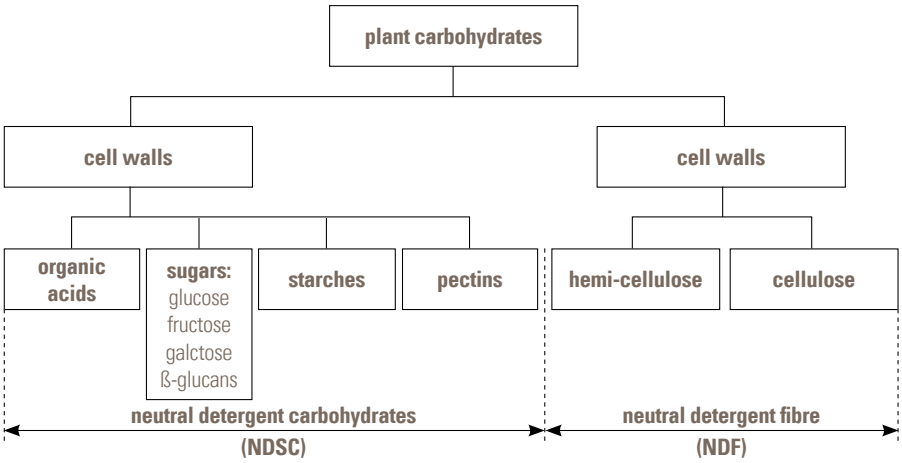

Figure 1: Carbohydrate fractions in plant feed material (source: Varga, 2003)

fermentation of digestible fibre, but is produced from pectins much more quickly in the rumen."

However, the most important characteristic of pectin fermentation is that it's self-regulating. Oversupply of starch, in contrast, will rapidly overload the rumen as production of propionate exceeds the ability of the cow to absorb it, with the excess being converted to lactic acid. The rumen pH drops, producing the classic symptoms of acidosis – poor rumen fermentation, low intakes, falling milk production.

Highly sensitive

In comparison, not only is acetate a much weaker acid than lactic acid (and so has a much less detrimental impact on rumen pH), the microbes that ferment pectins are also highly sensitive to acidity.

As a result, if acid levels in the rumen begin to increase and pH falls, pectin fermentation slows, only rising again when a proportion of the excess has been absorbed through the rumen wall and pH begins to return to normal.

"It's the perfect feedback loop, naturally buffering the pH of the rumen, and is very different to the situation for starch fermentation where the microbes involved are more than happy to keep going as the pH drops," says Dr Marsden.

"It's why feeds that are high in pectins, like sugar beet, perform better than simple proximate analysis would suggest, with the lower energy content in the trial mentioned earlier (Table 1) outweighed by the improvement in rumen fermentation efficiency.

"But we also know from the scientific literature that the digestible fibre from different feeds ferments differently in the rumen. Citrus pulp, for example, predominantly ferments to produce both acetate and lactate or lactic acid, whereas sugar beet feed ferments mainly to acetate."

And although US nutritionists are starting to recognise the importance of the NDSC fraction that includes pectins, particularly as milk yields increase, it's the difficulty in measuring an exact content of the various pectin-like compounds that currently prevents their inclusion in ration formulation in the UK.

However, the sheer amount that appears to be in some of these digestible fibre feeds (particularly when compared to the amount in most other concentrate feeds), plus the important role they plan in maintaining a healthy rumen, means that pectins shouldn't be ignored.

"It's why the experience and knowledge of your nutritionist is still so important, regardless of which particular ration formulation program is on their laptop," says Dr Marsden.

Better value

"Knowing how the cow responds to different feeds is the key as this allows identification of those feeds that tend to perform better than expected, work particularly well in certain situations, or offer better value than the price per tonne might suggest.

"And it's clear from examining the data relating to pectins that when it comes to buffering the rumen against acidosis and maximising the efficient conversion of feed into growth or milk, there's more to these digestible fibre feeds than many realise," he adds.

So, when looking to balance high levels of starch-based concentrates and maintain a healthy rumen fermentation, don't forget to think about the pectins. |