

# TechNote 8

## Fibre metabolism

### IN THIS TECHNOTE

- 8.1 Dietary fibre measurements
- 8.2 Dietary fibre recommendations
- 8.3 Further reading

Fibre is the structural material of the plant cell wall. Dietary fibre consists of the two structural carbohydrates (cellulose and hemicellulose) and the indigestible compound lignin. Lignin is not a carbohydrate, but binds to the structural carbohydrates, making them less accessible to rumen enzymes, therefore less digestible. The lignin content of plants increases with age, therefore the fibre in the plant becomes less digestible as it matures.

### 8.1 Fibre measurements

Dietary fibre has three feed components.

- **Neutral detergent fibre (NDF)** is the material that remains after treating the plant with a neutral detergent. This measures the structural carbohydrates (cellulose and hemicellulose), and lignin.
- **Acid detergent fibre (ADF)** is the material that remains after treating the plant with an acidic detergent. This measures the least digestible components, cellulose and lignin. ADF is often used to indicate the digestibility of the feed.
- **Effective NDF (eNDF)** is a term often used to indicate the fibre that is most efficient at stimulating rumination and saliva production. However, there is ambiguity in the terminology used to describe 'effective fibre', and limited accuracy in these measurements for pasture. Effective fibre (eNDF) was originally determined as the amount of fibre required in the diet to maintain milk fat, whereas, physically effective fibre (peNDF) is related to the chop length or particle size of the fibre components.

Determining eNDF or peNDF is not easy for pasture. In an attempt to ascribe a value to pasture, estimates for eNDF have been made based on common characteristics (e.g. rumen pH and passage rate of feed) of similar feeds such as silage. Mathematical tools (meta-analysis and modelling) using the Cornell Net Carbohydrate and Protein System (CNCPS) estimated the eNDF of good quality pasture to be about 43%. However, the range is large, from 29 – 78%, and eNDF is not a good predictor of rumen environment (pH, motility, VFA production).

For supplementary feeds, eNDF and peNDF can be measured more accurately and are stronger indicators of rumen function. Feeds such as hay and straw are very high in eNDF; whereas cereal grains are low.



For more details see TechNotes 3: *What's in a feed*, and 5: *Carbohydrate metabolism*, and online eLearning activity: *The role of fibre*; [dairynz.co.nz/feedright-module-6](http://dairynz.co.nz/feedright-module-6).

## 8.2 Dietary fibre recommendations

Dietary fibre is needed by the cow to maintain healthy rumen function. Eating fibre stimulates chewing, saliva production and rumination. Saliva contains sodium bicarbonate (more commonly known as baking soda) and phosphate salts and these help to buffer the rumen pH, and promote the growth of rumen microbes.

Dietary fibre recommendations differ depending on the base diet. The rumen environment (volume and stratification of rumen contents, passage rate, chewing times) of grazing cows differs from that of cows fed a total mixed ration (TMR), or high levels of starch/sugar based supplements. This is why recommendations for fibre requirements based on TMR or high supplement diets need to be used with caution in pasture-based systems (and vice versa).



Fibre stimulates chewing, saliva production and rumination, and is required to maintain a healthy rumen function.

### 8.2.1 Diet NDF and rumen pH recommendations

Common recommendations are:

- for cows grazing high quality pastures, NDF should make up a minimum of 35% of the diet and eNDF 17%.
- for cows eating diets high in starchy feeds such as cereal grains, NDF should be at least 27% and eNDF 20%.

Differences also exist in the recommended minimum rumen pH levels. Cows grazing good quality pastures can tolerate a lower rumen pH without detrimental effects on rumen function, compared with those eating a total mixed ration, or a diet high in starch. This is primarily due to:

- the different carbohydrate contents of the two types of diets,
- the different rumen microbial populations that digest the different carbohydrates,
- the different waste products produced from carbohydrate digestion.

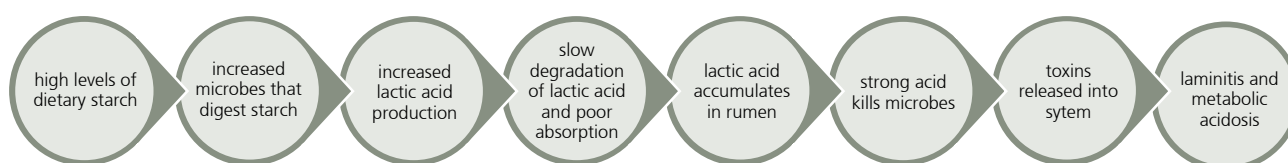
### 8.2.2 Supplementary fibre recommendations

If cows are eating a diet high in sugar or starch, and dietary fibre is less than recommended, rumen acidosis can occur (Figure 1). Adding fibre, in particular a feed high in eNDF, will improve animal performance (rumen pH, motility, VFA production). However, when good quality pasture makes up the majority of the diet, adding a feed high in eNDF (e.g. straw) is not similarly effective in inducing rumination, or altering rumen function (pH, motility, VFA production). In fact, the addition of a low energy, high eNDF feed to a pasture-based diet can reduce energy intake and milksolids production.



For more details see TechNotes 5: Carbohydrate metabolism, and 18: Allocate required nutrients, and online eLearning activity: The role of fibre; [dairynz.co.nz/feedright-module-6](http://dairynz.co.nz/feedright-module-6).

Figure 1. Steps involved in rumen acidosis.



### 8.3 Further reading

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