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Alberta Dairy Management

PREPARED FOR AND DISTRIBUTED BY THE DAIRY EXTENSION ADVISORY GROUP

Fibre for Lactating Cows

Feeding early lactation cows demands a fine balance between energy and fibre requirements. High ration energy levels are required to achieve peak production while fibre is needed to keep the digestive system functioning efficiently. However, since fibre is relatively indigestible, ration energy level inevitably falls as the fibre level increases.

Chemical and physical fibre

It is important to distinguish between *chemical fibre*, as measured in the feed lab,and *physical fibre*, provided by long forage. Long hay will contain the identical level of chemical fibre as the same hay finely ground. But its physical fibre value is completely lost in grinding.

Chemical fibre is measured in the feed lab as acid-detergent fibre (ADF), consisting mainly of cellulose and lignin, and neutral detergent fibre (NDF) which also includes hemicellulose. Both cellulose and hemicellulose are digestible by fibre-digesting rumen microbes and are, in fact, essential to the maintenance of this population. Since the cow must consume forage, a healthy population of fibre-digesters is required to keep the system moving. When high levels of starch are fed, the number of fibre digesters may be reduced as a result of increasing rumen acidity.

Lignin, the 'glue' that gives mature plants their rigidity, is totally indigestible. The ADF and NDF fractions of mature plants contain a higher proportion of lignin and that lignin also interferes with digestion of the other fibre components.

Chemical treatment of mature forages (and even wood wastes) can break the bond between lignin and cellulose, resulting in increased fibre digestibility. Some of our by-product feeds, because of the processing they have been through, contain highly digestible fibre. Beet pulp is one of these. Although its NDF content (around 54%) is as high as full-bloom alfalfa, its energy value (NE_l= 1.8 Mcal/kg) is higher than oats. Where alfalfa's NDF is about 20% lignin, beet pulp's is only about 4%. Brewers and distillers grains also contain very digestible fibre. Inclusion of these by-products makes it possible to achieve high ration energy levels while satisfying the cow's chemical fibre requirements and reducing intake of feed grain starch.

Physical fibre, or *structured roughage*, keeps the rumen functioning normally. Chewing is required to break down large fibre particles, and chewing promotes salivation. A cow yielding 30 to 40 kg of milk may secrete as much as 45 gallons of saliva daily. This amount of fluid being produced high up in the digestive tract washes feed particles through the rumen into the lower parts of the system. In addition, saliva contains buffers which serve to prevent the contents of the rumen from becoming too acidic.

Structured roughage also provides a 'tickle factor' which stimulates rumen contractions. These help to keep the rumen contents well mixed and to force fluid and small particles further down the digestive tract. A third function of long forage is the maintenance of a fibre mat which floats in the rumen and functions as a particle sorting system. Long particles near the top of the mat are the first to be regurgitated for cud chewing. Chewing subdivides and adds water to the particles. When they re-enter the rumen, they 'float' at a lower level than the longer, drier particles they were derived from. A functional mat also stabilizes rumen fermentation by trapping fine particles, reducing access by rumen microbes and slowing their rate of breakdown.

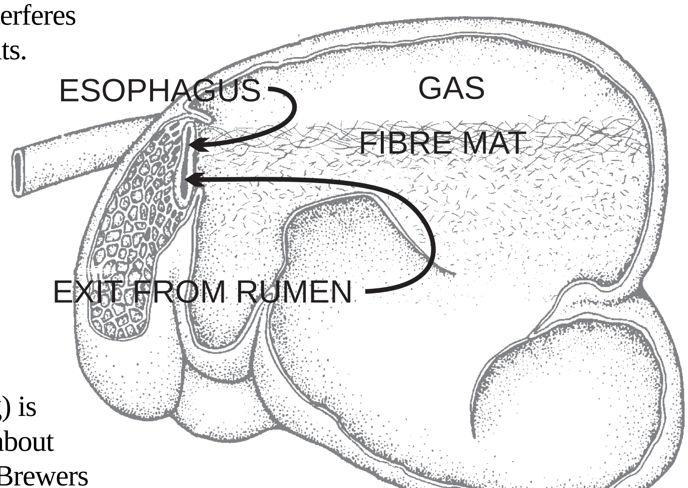

Figure 1 : The fibre mat and particle sorting in the rumen.

Effective fibre

Effective fibre is a term used to describe the physical fibre value of a feed. Since NDF measures the total chemical fibre in a feed, effective fibre can be expressed as the percentage of the NDF which is effective in promoting chewing, salivation and fibre mat formation. For example, the NDF in long alfalfa hay might be considered 100% effective (EffNDF as % of NDF = 100%). If the NDF value of that hay was 40% on a dry matter (DM) basis, then the EffNDF (as % of DM) would also be 40%.

Evaluation of the effective fibre value of a feed has been, at best, intuitive. For want of a more rigorous method, many dairy nutritionists have adopted a system which equates effective NDF with NDF from forage. It is assumed that the NDF is 100% effective in all forages and that concentrates contribute no effective fibre, irrespective of their NDF content (EffNDF = 0% of NDF). This system facilitates compliance with current NRC feeding guidelines which suggest that minimum ration NDF levels for lactating cows should be in the 25-28% range and that 75% of this NDF should be provided by forage. Using these guidelines, rations should be formulated to minimum EffNDF levels in the 19-21% range.

NRC recommendations are based on research trials where corn has been the primary feed grain. But, when corn is replaced with barley, rations formulated to total NDF levels in the 25-28% range may contain as little as 12% forage NDF. This is because barley contains approximately twice as much NDF as corn (e.g. 19% for barley vs. 9% for corn) and, therefore, barley NDF contributes significantly more to total ration NDF.

Results of short-term feeding trials at Agriculture and Agri-Food Canada's Lethbridge Research Centre indicate that lactating cows can be fed barley-based rations containing significantly lower forage NDF levels than those recommended by NRC, provided that the forages used in these rations are coarse-chopped (see article **1N2**). But how do you evaluate whether a forage is chopped coarse enough to be used in a low forage NDF ration?

Forage particle size

Every farmer and nutritionist uses some method to evaluate forage particle size. More often than not, the evaluation is subjective **-** a quick glance at the feed, looking for those long particles. Researchers have suggested that a sample of feed could be manually separated into fractions of different lengths, followed by weighing each fraction. But few nutritionists in the field have felt that this would be time well spent.

Recently, a practical forage particle separator has been developed at Pennsylvania State University and offered for sale through Nasco Farm Supply. The separator consists of a top screen with 0.75 inch holes, a second screen with 0.3 inch holes and a bottom pan. As shown in figure 2, a sample of forage is placed on the top screen, the separator is shaken and the amount of forage remaining in each of the 3 sections is weighed. If the resulting particle size distribution indicates insufficient long particles, additional coarse forage can be added to the ration.

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Figure 2 : Forage particle separator developed by Pennsylvania State University and available from: Nasco, 4825 Stoddard Road, Modesto CA 95356-9318, (209)545-1600. Price quoted in the 1996 Nasco catalog was US$195.