



## Fiber Does NOT Stand Alone in Ration Formulations...

By James DeMatteo, Nutritionist

Protein, fat, ash (minerals), NDF (fiber), NFC (starches and sugars) and water are the main broad nutrient categories to consider in ration formulation.

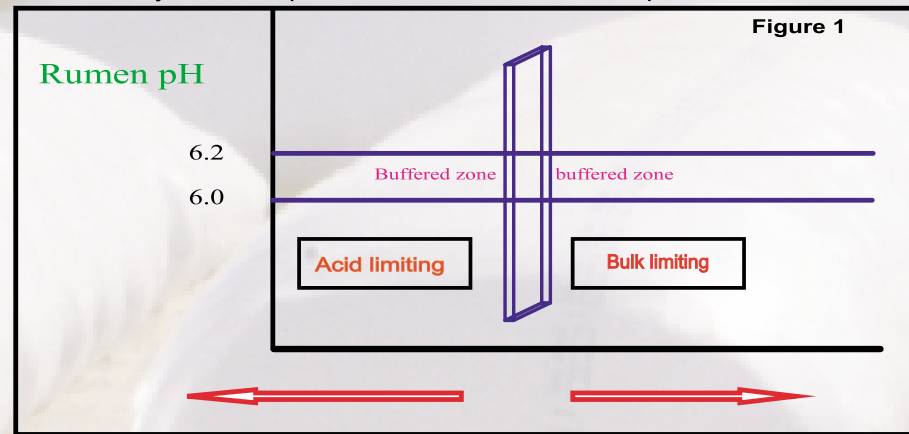
By definition, the word “balance” means; “to bring to, or hold in a state of equilibrium.”

In ration formulation, what we have here is a number of nutritional forces that need to line up into equilibrium in order to achieve optimum production, reproduction and health. The forces of carbohydrates and fibers interact so much that the ‘2001 Nutrient Requirements for Dairy Cattle’ covers the fiber topic under the single chapter heading of “Carbohydrates”.

Now those of us in the forage business would sure like to have

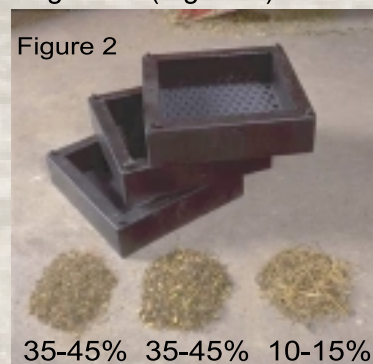
our own chapter in the new National Research Council, Nutrient Requirements for Dairy Cattle. I mean this is the seventh revised addition, and you mean to tell me that fiber doesn’t even get it’s own chapter?!?! Well, the good news is that fiber plays such a significant role in dairy nutrition and interacts so significantly with carbohydrates, protein and even dry matter intake – that it is covered throughout the newest NRC guide and specifically in the carbohydrate chapter.

J. of Dairy Sci. 82-589). Too high of a level of carbohydrates relative to the amount of NDF in the diet can result in acidosis. Figure 1 shows a graph illustrating the delicate balance where rumen pH is optimal (between 6.0 and 6.2) and where the pH is suboptimal because of low pH or because of bulk limit. Forages that are coarsely chopped provide NDF in a form that is distinctly different from NDF in non-forage sources such as beet pulp, soy hulls or malt sprouts. This is the



NDF (neutral detergent fiber) can provide a measurement of “gut-fill”. At high NDF concentrations in diets, rumen fill limits dry matter intake whereas, at low NDF concentrations energy intake inhibitors limit dry matter intake. In short, too much physical fiber fills up the gut and limits the amount of goodies that a cow can eat. However, the chemical composition of the fiber also plays a part in the digestion of NDF. Oba and Allen showed that with an increase in NDF digestibility dry matter intake increases (Oba and Allen 1999,

dividing line between chemical fiber – NDF, and physical fiber – as measured by the Penn State forage box. (Figure 2)



The goals of effective fiber levels as measured by the Penn State

The goals of effective fiber levels as measured by the Penn State forage box are 35 –45 %, 35 –45 %, and 10 – 15 % on the bottom – center – and top screens, respectively. Your consulting nutritionist may have varying recommendations, depending on the characteristics of your total mix and their interpretation of “what the cows are telling us”. This level should provide adequate effective fiber to build rumen mat while maintaining adequate overall digestion.

We have seen an increasing trend towards higher levels on the top screen of the PSU forage particle shaker. It’s just plain old human nature that tells us that if a little bit is good, then a lot is better. Taken to it’s extreme, too high of levels on the top screen present an opportunity for cows to sort coarse and fine feed particles – this promotes acidosis – because we really are not feeding a “true TMR” formula if the cows sort. The result will be sub-clinical acidosis, sub-optimal milk production, and erratic manure throughout the pen. If we want to feed a true TMR we need a consistent mix with more even particle size.

*So, if soy hulls are \$ 50.00/ton less than good alfalfa hay, should we feed the soy hulls or the hay?*

Dietary NDF is only 35 % as effective at maintaining rumen health as roughage NDF – Allen (1997). Every situation is

unique, however , we need to consider *both* the chemical (NDF) and the physical characteristics of fiber. If you look at the nutrient analysis of early maturity and mid maturity hay, soy hulls and beet pulp – even though the “chemical NDF analysis is similar – remember that they act very differently in the rumen! The chart below illustrates my point.

| Nutrient      | Alfalfa Hay (Immature) | Alfalfa Hay (Mid Maturity) | Soybean Hulls | Beet Pulp |
|---------------|------------------------|----------------------------|---------------|-----------|
| Crude Protein | 22.80                  | 20.80                      | 13.90         | 10.00     |
| NDF           | 36.30                  | 42.90                      | 60.30         | 45.80     |
| ADF           | 28.60                  | 33.40                      | 44.60         | 23.10     |
| Lignin        | 5.90                   | 6.40                       | 2.50          | 1.60      |

We may actually be able to purchase the combination of a protein source (ie. Soybean meal) and non-forage fiber source (ie. beet pulp) more economically than a comparable forage source. In reality, the *total balance* requires the proper combination of effective fiber and chemical fiber, as measured in the

laboratory. Although the chemical (NDF) fiber of soy hulls and beet pulp is very digestible and offers a lot to the total balance in nutritional formulation, it does not meet the need of particle size that properly processed hay, haylage or corn silage will provide. Rumen health is dependent upon particle size, particle structure, and NDF content (chemical fiber).

The interaction between carbohydrates and fiber is pivotal to nutritional *balance*. High long-term milk production and the maintenance of rumen health are inseparable... And forage is the foundation of that balance.

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