Nutrition 101: Carbohydrates II

By Lark L. Burnham, Ph.D. | Ruminant Nutrition

Although other factors may be involved, carbohydrates can be considered as on a continuum of water solubility. At one end of the spectrum are the soluble carbs, sugars and starches, which were discussed last issue. At the other end are almost totally insoluble carbohydrates such as seed hulls and mature structural material such as stems and stalks. In between are found semi-soluble fiber sources such as pectin and flax seed. This issue will discuss less soluble carbs.

Water solubility is used to denote carbohydrate digestibility because water absorption is the key to unlock nutrients. All mammals lack the enzymes necessary to digest fiber. They rely on microorganisms to do this, and then absorb the energy generated from microbial fermentation. The more soluble a fiber source, the more energy derived from it. Ruminants and pseudo-ruminants have evolved compartmentalized stomachs that promote microbial fermentation.

As plants mature, they replace soluble structural material with insoluble fiber. The amount of sugars and starches in the plant also decrease and become less accessible to animals. In the final stages of maturity, seeds are released and the plant life cycle ends.

Rumen digestibility is a combination of nutrient availability and passage rate. The rumen is uniquely designed to hold and mix material for prolonged exposure to microorganisms. Nutrient availability is limited by amount and type of fiber, as well as extent of processing. Forages may spend as long as 3 to 4 days in the rumen before passing to the next compartment. Fermentation does not cease once material exits the rumen, although it is slowed considerably. Acidity and water availability change rapidly as rumen contents pass into other compartments and the intestines. These conditions, plus a more rapid transit time, are not conducive to microbial fermentation.

Many beneficial microorganisms that predominate in forage-fed rumens belong to a group known as "lactic acid bacteria". These microbes have a protective role, and keep pathogens from proliferating.

Although forages and pasture provide most of the semi- to insoluble carbs for ruminants and pseudo-ruminants, seed coats or hulls also belong to this group. Seed *contents* are usually soluble carbohydrates like starch and protein. The hull protects the contents from weather and digestion in many animals. Unprocessed seeds often pass right through without being harmed. This is due to the tough, insoluble hull.

In order for ruminants and pseudo-ruminants to get more from seeds, further processing is often required. Flax seed is atypically soluble. Seed contents become available to animals if the seed is mechanically processed prior to ingestion. This includes:

- Grinding
- Flaking
- Rolling
- Heat and/or steam treatment

However, finer is not always better. Grain which is too fine can be fermented very quickly and can lead to founder or acidosis. Cracked, rolled, or flaked is better.

The digestibility of plant material decreases during maturity. Harvest time is a balance between quantity (amount of dry matter) and quality (digestibility). The peak for the latter actually precedes the former. Nutrient availability is at its peak before the plant forms flower buds.

Hay or pasture is essential for ruminants and pseudo-ruminants, these feedstuffs should comprise the majority of the diet

for actively ruminating animals. Although the rumen can adapt to high grain diets, such as those fed to feed-lot cattle, fibrous feedstuffs provide more than energy.

Many beneficial microorganisms that predominate in forage-fed rumens belong to a group known as "lactic acid bacteria". These microbes have a protective role, and keep pathogens from proliferating. Many of the bacteria used in livestock probiotics belong to this group. Forage in its own right has benefits for the rumen. It provides the "scratch factor" that promotes a healthy rumen environment.

Ruminants and pseudo-ruminants thrive on pasture and well-cured hay. Pasture should not be allowed to reach maturity to maximize digestible nutrient intake. If forage is left un- or under-grazed, it will bloom and nutrient availability will decline. Such pastures should be mown or shredded to promote new growth.

About the author:

Lark Burnham received a B.S. in Animal Science (1979), from Kansas State University and a M.S. in non-ruminant nutrition (1995) from Kansas State Universtity, Manhattan, and a Ph.D. Doctorate in ruminant nutrition (2004) from Texas Tech University, Lubbock. Her special interests are comparative nutrition, the role of the micro flora in all mammals, fiber digestion, and probiotics. Lark currently works for Natur's Way. Inc., Horton, KS, which produces MSE probiotics.