THE GRAIN DILEMMA: Part 2

BY LARK L. BURNHAM, PH.D.

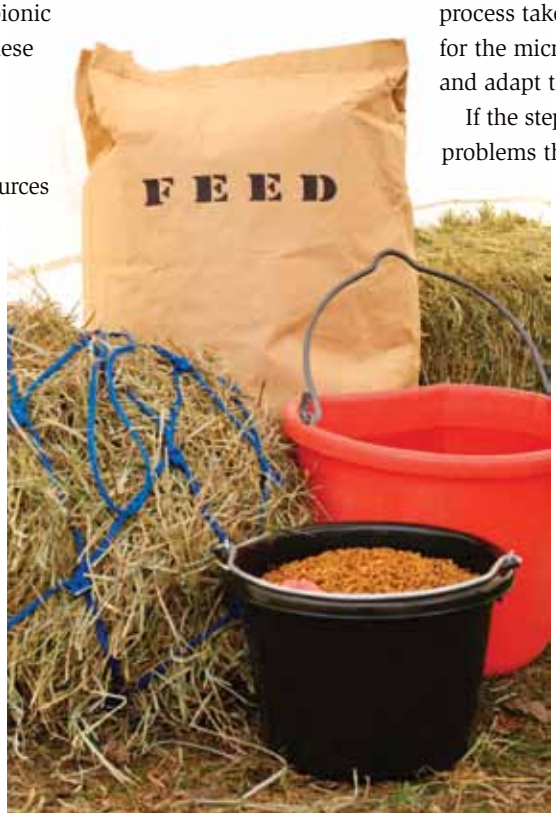
The first part of this article, which ran in the Spring 2011 issue, opened a Pandora's Box of grain-related questions. Those discussed in the current article grew from a grain (pardon the pun) of truth. Once again, it is necessary to explain some of the mechanics of the rumen/C1.

It was mentioned in the previous article that the rumen contains approximately 400 species of microorganisms, including bacteria, yeast, and protozoans. However, only a handful of species dominate, based on the diet and stress level of the animal at any particular time. The dominant species change several times over the course of the animal's lifespan.

The rumen/C1 is lined with finger-like projections called "papillae." These allow the passive transfer of volatile fatty acids, or VFA, from the rumen to the blood stream. Volatile fatty acids, also called short-chain fatty acids, are the product of microbial fermentation. Three of the most prominent are acetic acid, propionic acid, and butyric acid. Note the fact that these are acids.

The VFA are easily absorbed all along the digestive tract, and then sent via the blood stream to the liver. There they are used as sources of energy.* The fermentation of roughage in the rumen takes three to four days and yields a slow, steady stream of VFA, readily absorbed by the papillae.

In contrast, when grain or alfalfa are fermented, they produce a quick burst of VFA, usually in as little as an hour or two after ingestion. As long as grain provides less than 50 percent of the total diet, the VFA generated are easily assimilated. There is absolutely no reason any alpaca should be fed grain grain quantities anywhere near 50 percent of the total diet.



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Acidosis

The scenario in the rumen of feedlot cattle can be used to describe what happens when grain and grain by-products are fed at levels above 50 percent of the total diet.

Cattle producers have learned to exploit the "big burst" vs. "slow simmer" to their advantage. Cows with calves graze on pasture during the growing season. The pasture grass roughage supplies a steady stream of energy that keeps the milk flowing and the calves growing.

Each fall, the calves, now weighing several hundred pounds, are removed from their mothers and sent to either what is called a "back grounding" operation or directly to the feedlot. Backgrounders bring the weaned calves up to a weight that is acceptable to feedlot operators. Once in the feedlot, they are "processed" (in jected and/or implanted with hormones) and put on a regimen that steps them up to the goal of 95 – 97 percent grain and grain by-products. This process takes a minimum of 14 days. It takes this long for the microorganisms in the rumen to reorganize and adapt to the grain diet.

If the step-up is done too quickly, calves can develop problems that may be either debilitating or fatal. Here is where the term "acidosis" comes into play. (Note that we are talking about cattle on very high grain diets.)

Remember that the papillae in the rumen have no trouble absorbing the VFA generated by a predominantly roughage diet. Now consider what happens when the rumen is flooded, over and over again, with VFA generated by a grain-based diet.

If the rumen is allowed to adapt properly before this happens, the correct microbial species will dominate, and the papillae will have grown longer (presumably to increase VFA absorption). Jumping to a diet that is mostly

grain and grain-by products before this has taken place is a recipe for disaster. The rumen fills with unabsorbed VFA (which are acidic) and the animal gets a belly ache. It will go off-feed, which will cause another shift in microbial populations. The animal will cycle through periods of extreme discomfort, followed by no feed intake. Growth performance will be poor, pathogens will proliferate, and the animal will get very sick or die. This is acidosis.

Again, there is absolutely no reason any alpaca should be fed anywhere near the levels of highly fermentable carbohydrates that would culminate in this disease. Feeding a cup of pellets or grain a day, as a supplement to hay or pasture, will not cause acidosis.

Ulcers

Another problem that makes alpaca producers anxious is ulcers. There are two situations that promote rumen erosion, or ulceration. The first is high acid content as described above. The predominantly forage-fed rumen usually maintains a pH at or above 6.0, just below neutral. Cattle on a high grain diet have a rumen pH below 6.0 and some may even dip below 5.0, decidedly acidic. When acid takes longer than normal to be absorbed by the papillae, it can irritate and erode the rumen lining. Again, please note this is in cattle fed high grain diets.

The second cause for ulcers is stress. At first, it would seem logical to blame acid for this as well. However, research in both humans and livestock has demonstrated that the erosion due to stress is actually caused by microorganisms.

In the healthy rumen, the dominant microbial species are beneficial. Lactic acid bacteria predominate in the roughage-fed rumen. The LAB, as they are called, keep the rumen pH just a little too acidic for most pathogens, but still above 6.0.

When an animal (any animal, including humans) gets stressed, several things happen. There are rapid-fire hormonal releases that redirect energy from the gastrointestinal tract (a major energy hog) to the muscles, so the animal is ready to flee or fight.

Many stressed animals also stop eating. If the stress isn't extreme or is short in duration, the hormone rush passes out of the system and life goes on as usual. However, if the stress is chronic (like interminably bad weather, long transport, or chronic pain) or severe, then it may take days or months to get back to normal. Major stresses include birth (for both Mom and baby), weaning, shearing, transportation, and showing.

One major stress can trigger a drastic upheaval in the microbial populations of the rumen/C1. Many beneficial microbes die from starvation, or become weak enough to be overpowered by opportunistic pathogens. Many pathogenic microorganisms are not particularly good at competing for nutrients and living space. They need just such a shake-up to proliferate.

Opportunistic pathogens can generate an entire spectrum of symptoms, ranging from no real effect to serious illness. Not only do they dominate the available nutrients,

they also take up valuable real estate and tear up the neighborhood, so to speak. Some species are not content to wait for whatever comes down the pike (esophagus). They start digging, and may even invade vital organs.

This latter group is responsible for tissue erosion, which can happen all along the digestive tract. Each species prefers a different area. The result is deterioration of the fragile and supremely important lining. This is where VFA, minerals, and vitamins are absorbed into the bloodstream. If the erosion is allowed to continue, perforation can occur, with lethal consequences.

Ulceration is a very real problem in stressed animals. Veterinarians may prescribe a wide spectrum antibiotic to control pathogen proliferation. However antibiotics can cause trouble in the rumen of animals so dependent on microorganisms. Fortunately, there are alternatives.

Probiotics, or direct-fed microbials, are beneficial microorganisms that can compete with opportunistic pathogens. Various species have been identified as successful competitors. These are often lactic acid bacteria, the good guys mentioned above. They can be given preventively, before a scheduled stress, or after the fact for those which are unanticipated.

Probiotic microorganisms are transient in most cases. They need to be given daily to maintain protection or treatment. Numbers of live bacteria are indicated by "colony-forming units" or CFU (one microbe can grow into a whole colony). The ideal concentration for major stresses is at least one billion CFU (1 x 109) total microorganisms. Make sure the product has a "guaranteed analysis" of 1 billion CFU or higher. Species that are often included in probiotic products include *Lactobacillus* sp., *Streptococcus (Enterococcus) faecium*, and *Saccharomyces cerevisiae.* The products with the highest concentrations are sold as either paste or liquid (drench).

Be aware of events that might cause major stress. Treat preventively for at least a few days before, and a few days afterwards. Also be aware of any change in food intake following such a stress. This means up to two or three months later. It takes time for microorganisms to proliferate, both beneficial and pathogenic. Often, the initiating event is a distant memory by the time symptoms become obvious.

Other grain/alfalfa related issues

Some producers shun grain and/or alfalfa because they have heard or read that alfalfa A) is high in calcium; and B) can reduce fiber quality.

To reply to these comments, a typical feeding routine will be described. This may include a pelleted or extruded feed that contains roughage by-products, grain by-products, a protein source of some kind, as well as a whole list of vitamins and minerals in unspecified quantities. A fiber nutrient supplement may also be fed. This contains among other things, calcium and phosphorus. Free-choice mineral mix is also available at all times.

By itself, each supplement may provide the daily requirement for calcium. That means that animals fed combinations of these supplements may actually get two or three times that much.

More is not better when it comes to minerals. There are interactions that may cause trace mineral deficiencies or toxicities. Now add alfalfa to that mix, usually fed to lactating females or to help underweight animals gain weight. By itself, alfalfa is not exceedingly high in calcium. However, add it to the pile and suddenly you have a calcium interaction problem. Just as an example, zinc, which is a trace mineral vital for fertility in both sexes, is now deficient.

The same can be said for protein, which has already been described as a rapidly fermented energy source. Too much protein is like too much grain all at once.

An alpaca producer recently asked for an alternative to corn because she had heard that this grain damaged the lining of the intestinal tract. The fact is the process of digestion is, in itself, damaging. Hydrochloric acid (secreted in the stomach, abomasum, and C3 of non-ruminants, cattle, and alpacas, respectively) is necessary to break down feed components that resist microbial fermentation.

The gastrointestinal tract replaces itself every several days for this reason. This is also one of the reasons it uses so much energy. Chemical and physical damage are part of the digestive process. Hay retains its identity for a long time in the rumen/C1, which means that sharp stalks can puncture fragile tissue. Hay can do a lot more damage than corn, yet no one is suggesting that we stop feeding it. Nor should they—hay is the only real alternative to pasture.

Diet and fiber quality

Excess nutrients not only make the animal fat, they can make the fiber "fat" (increase the diameter) as well. Within genetic constraints, the finest fiber is produced by minimizing or eliminating these excesses. Try to keep all alpacas at ideal weight. Excess protein and energy in any form will decrease fiber quality.

Conclusions

Grain and grain by-products can be safely fed to alpacas in moderation. Hay and/or pasture should always dominate the adult alpaca diet. Avoid mineral interactions and rely on a good local mineral mix, rather than multiple pelleted supplements. And finally, any need for protein and energy supplementation should be made based on body condition, not what the bag label tells you.

*Editor's note: *Some studies show that over 70 percent of a ruminant's energy supply comes from volatile fatty acids (FVAs). The rumens of animals on diets poor in nutrition must undergo physical changes before they can absorb the VFAs produced by better diets.*

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