



# CATTLE SENSE

Information that makes sense helping you make cents

No. 92 June 2008

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## // Protozoa Primer

Back when I was enrolled in Rumen Microbiology, I thought it was just the coolest class. Fellow graduate students approached lab time spent observing the microscopic life of rumen inhabitants with a “well, if we have to.” I, in contrast, was fascinated. There, living in just one ml of rumen fluid, were 1,000 bacteria of various shapes, abilities, and dietary processes; 100 fungi working synergistically with them; and, 100 relatively gargantuan protozoa bullying the neighborhood.

The protozoa in particular caught my attention. Even though there are far fewer of them than the bacteria, they are so much larger they typically make up about half the biomass in the rumen. Yet when a calf is born, there are no protozoa within its system. It won't become “faunated” (populated with ruminal protozoa) until sometime between 6 weeks and 6 months of age, thanks to transfer from other animals via grooming or shared feed and water sources. There are two types of protozoa found in the rumen: holotrichs and entodiniomorphs. They have cilia, or little hairs, on the outside of their one-celled bodies, which aid in movement and drawing food towards them for ingestion.



### Good Guys or Bad Guys?

Ruminal protozoa can play a significant, if not entirely positive, role in the digestion process. These organisms have the ability to degrade hemicellulose, which can leave feed particles more accessible for bacterial fermentation activity. They also utilize sugar and starch, putting them in a competitive situation with the bacteria and fungi. And the entodiniomorph group of protozoans are actually predators of rumen bacteria. Thus, a large protozoa population leads to fewer bacteria. Recent research from Japan also showed that faunation “markedly affected” the bacterial species make-up.

Now, if the protozoa moved through the host animal's system the way bacteria do, none of this would matter. But because of their relatively large size, most do not pass to the small intestine. With 70-80% of the protozoa--along with the starch granules, sugar, and bacterial cells they have engulfed--held back from the flow of nutrients, the net flow of microbial cell protein is reduced. Fewer bacterial numbers also mean reduced fermentation and release of VFA (Volatile Fatty Acids) as an energy source for the cow or calf. German research has also demonstrated production of less favorable fermentation end-products in faunated vs. unfaunated calves. When protozoa were present, the acetate:propionate ratio was higher, less of the nitrogen in the rumen was in the form of amino acid proteins, and methane production was increased exponentially. Once the protozoa die, the compounds in their bodies are once again available for digestion within the nutrient pool of the rumen. But microbial efficiency (flow of microbial cell protein relative to feed consumed) is naturally reduced by this intermediate step.

Protozoa may serve a useful role in animals that take in large amounts of readily-degradable energy feeds in a short period of time. This type of “slug” feeding can predispose animals to digestive upset as bacteria rapidly convert this feed to VFA, lowering pH and altering microbial activity. Protozoa engulf starch particles for digestion, essentially keeping this substrate out of reach of the bacteria for the time being, and moderating the rate of carbohydrate fermentation.

On the other hand, it has been shown that protozoa may get carried away with an overabundance of available nutrients, to the detriment of both themselves and their host. In animals consuming very lush pasture (i.e., wheat, alfalfa) these organisms may essentially overeat to the point they actually burst. This releases compounds that support the formation of froth in the rumen. If enough protozoa “pop” at once, this can be a major contributor to pasture bloat.

### **Can they be eliminated?**

The concept of purposely defaunating cattle has been considered for decades. In 1967, researchers at Kansas State University screened 170 different chemical agents for their potential to eliminate ruminal protozoa. Multiple studies since then have more specifically looked at the impact of various defaunating agents. Ionophores have anti-protozoal properties, which may explain the positive impact they sometimes have in reducing pasture bloat. Some medium chain fatty acids, for example, have been shown to reduce protozoa numbers, with a concurrent reduction in methane production. Generally speaking, growth responses to protozoa removal have been seen in studies where dietary protein was limiting.

The problem is, defaunation is transient. Cattle will either pick protozoa back up from other animals, or the rumen will repopulate internally with protozoa that were safely residing in the reticulum or omasum when the defaunating agent was present in the rumen.

### **Other options?**

Yucca plants contain saponins, natural detergents which have a negative impact on protozoa. Research trials have linked feeding these compounds to reduced numbers of protozoa, increased levels of microbial cell protein, reductions in blood and milk urea nitrogen, and increased propionate:acetate ratios. Several commercial feed additives are available that contain yucca extracts, preferably from the specific plant species *Y. schidigera*. In an *in vitro* study presented at the 2007 Plains Nutrition Conference, inclusion of a yucca schidigera extract resulted in a 34.2% increase in the quantity and 42.9% increase in the efficiency of microbial nitrogen synthesis. When fed continuously as an additive in feed or supplement, the issue of recurring populations can be addressed on an ongoing basis.

### **Where does defaunation fit?**

As with any management option, the decision to implement needs to be based on the potential return on investment. While the numbers aren't yet definitive regarding the net impact of rumen protozoa, defaunation may be a profitable practice, at least in situations where dietary protein may be limiting, or the risk of pasture bloat is high.