Polioencephalomalacia (PEM or Polio) Associated With Feeding Corn Gluten

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Corn gluten is very commonly used as a feed co-product in Virginia. Corn gluten feed is a co-product of the production of high fructose corn syrup. The corn syrup is removed by a wet milling process. Wet milling separates the corn kernel into starch, oil, protein, and bran. The corn kernels are soaked in sulfurous acid to soften the kernel. The resulting steep liquor contains protein, minerals, vitamins and energy sources. The starch and oil are extracted from the swollen kernel. The remaining fiber or bran is mixed with the steep liquor. This co-product, wet corn gluten feed, contains about 40% dry matter. The wet corn gluten feed is often dried to 90% dry matter and is called dry corn gluten feed. Corn gluten feed usually contains 20-25% crude protein. Because most of the starch has been removed corn gluten is safe to be fed to cattle at high rates without causing rumen acidosis and bloat. The decreased concern over calves eating too much grain and getting sick is one of the major positive aspects of corn gluten. It is a common practice to give calves free-choice corn gluten. Generally, calves will eat about 2% of their bodyweight in corn gluten when fed free choice. However, fast growing calves that have been on corn gluten over 30 days can eat a higher percentage of bodyweight than this.

In the past, there have been rare outbreaks of polioencephalomalacia (PEM) in groups of calves fed free-choice corn gluten. Recently, I have been involved in investigations into several cases of PEM associated with feeding free-choice corn gluten. The clinical signs of PEM are blindness, staggering, down, and seizures. The clinical signs are caused by laminar cortical necrosis (brain damage). Most cases of PEM are thought to be caused by thiamine (Vitamin B1) deficiency. B Vitamins are produced by the bacteria in the rumen and then absorbed and used by the calf. Classic cases of PEM are caused by thiamine deficiency because either the calf ingested thiaminases from toxic plants that destroyed the thiamine in the rumen before it could be absorbed or because the bacteria have been killed off and are not producing thiamine. It is now understood that sulfur toxicity can cause the same brain damage as PEM caused by thiamine deficiency. When sulfur levels in the diet are too high rumen bacteria produce too much hydrogen sulfide. The hydrogen sulfide is absorbed across the rumen wall into the blood stream. An increase in the level of sulfide in the blood interferes with cellular energy production. The brain has a high requirement for energy production and is unable to use some alternative energy pathways. Total sulfur intake in calves consists of the level of sulfur in the feed and the sulfur intake through water. Sulfur levels in the diet should not exceed 0.4% of the diet on a dry matter basis. Not all cattle consuming a diet containing 0.4% will develop PEM. Total water sulfur intake and decreases in rumen pH are important in the development PEM. Decreased rumen pH causes more sulfide gas to be produced and absorbed. While feeding high levels of corn gluten grain does not cause clinical rumen acidosis and bloat, the rumen pH in these calves will be lower than calves that are on a higher forage diet putting them at greater risk of developing PEM.

Injectable thiamine is the treatment of choice for calves with PEM. Thiamine is a prescription drug that must be purchased from a veterinarian and should be used under the order of your veterinarian. The dose of thiamine is 2.5-3 cc of thiamine per 100 pounds of bodyweight. Vitamin B complex contains thiamine at different levels. Plain Vitamin B complex contains thiamine but only at very low levels. It would take 50cc per 100 pounds of bodyweight of plain Vitamin B Complex to treat PEM. Some Vitamin B complexes sold under trade names like Super Vitamin B complex and Vitamin B Complex Forte contain more thiamine than plain Vitamin B complex. These products would require 5-6cc per 100 pounds of bodyweight to treat PEM. Ideally, the first dose of thiamine should be given intravenously (IV) but if caught early the intramuscular (IM) or subcutaneous (SQ) route will work. Early diagnosis and treatment is the key to successful treatment. Once significant brain damage has occurred it is irreversible and treatment will fail. Even though cases of PEM caused by sulfur toxicity are not thiamine deficient they still respond to treatment with thiamine. In these cases, the response to treatment is slower and requires longer treatment. Supportive care to prevent blind calves from injuring themselves and allow them access to feed and water will greatly improve treatment success.

Preventing PEM caused by feeding corn gluten can easily be accomplished by limiting the amount of corn gluten fed. Grass and hay are usually very low in sulfur. Feeding even small amounts of these feeds will dilute out the sulfur in corn gluten to safe levels. Feeding cattle 2% percent or less of their bodyweight in corn gluten almost assures that the level of sulfur in the diet will be low enough to not be of a concern. It is when you are going to feed calves corn gluten free-choice that care must be taken to ensure that calves will

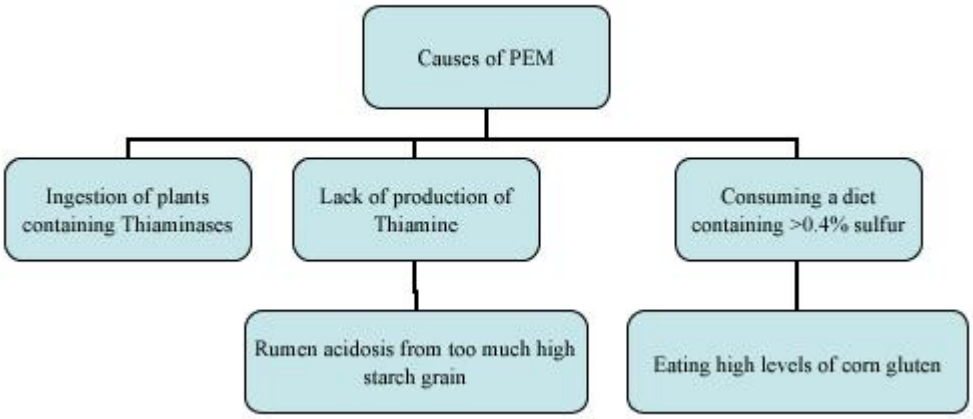
not intake to much sulfur. If feeding corn gluten free-choice (or more than 2% of bodyweight) to calves for more than 2 weeks then sulfur levels in the corn gluten should be checked prior to feeding the corn gluten. Sulfur levels can be measured at any forage analysis lab such as Cumberland Valley Analytical Services or DairyOne. Measuring sulfur levels should cost less than $10 + shipping to the lab. Based on my best judgment, at this time, it appears that sulfur levels <0.6 percent should be okay to feed free choice. The book value for sulfur levels for corn gluten is 0.47%. Table 1 shows the sulfur levels of 500 corn gluten samples analyzed at DairyOne labs since 2000. As you can see, the level of sulfur varies considerably in corn gluten and can often exceed 0.6%. Table 2 shows the sulfur levels of 2 herds feeding corn gluten free choice that suffered from outbreaks of PEM.

Table 1. Sulfur levels in corn gluten samples

Year	# Samples	Avg. Sulfur %	High Sulfur %	Low Sulfur %	STD Deviation
2000-2001	22	0.51	0.695	0.325	0.185
2001-2002	21	0.581	0.86	0.303	0.265
2002-2003	39	0.493	0.65	0.37	0.156
2003-2004	44	0.527	0.772	0.281	0.245
2004-2005	54	0.49	0.669	0.311	0.179
2005-2006	75	0.608	0.818	0.397	0.21
2006-2007	74	0.48	0.616	0.344	0.136
2007-2008	68	0.462	0.574	0.351	0.111
2008-2009	105	0.443	0.544	0.342	0.101

Table 2. Sulfur levels in 2 herds experiencing PEM outbreaks while feeding high levels of corn gluten

Farm	Corn Gluten Sulfur %
A	0.69%
B	0.70%



Issued in furtherance of Cooperative Extension work, Virginia Polytechnic Institute and State University, Virginia State University, and the U.S. Department of Agriculture cooperating. Alan L. Grant, Dean, College of Agriculture and Life Sciences, and Interim Director, Virginia Cooperative Extension, Virginia Tech, Blacksburg; Wondi Mersie, Interim Administrator,1890 Extension Program, Virginia State, Petersburg.

March 29, 2010