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Calf Note #34 – Intestinal mucin

Introduction

Replacing milk-based protein ingredients in calf milk replacers often means replacement with a lower cost, less digestible ingredient. Many alternative proteins have been evaluated. Typically, animal performance (growth, intake, feed efficiency) and digestibility are determined. Researchers in France have reported differences in the production of mucin in calves fed milk replacers containing different protein sources.

What is mucin?

Mucin is a protein that contains a substantial amount of carbohydrate (called a glycoprotein). There are two types of mucin – the type that is secreted by the intestine and the type that is produced as part of the epithelial cell membrane. Mucin is the main component of gastrointestinal mucous and, therefore, contributes significantly to the nitrogen that is secreted by the intestine into the lumen of the intestine. The function of mucous (formed by combining water and mucin) in the intestine is to lubricate the lining of the GI tract, protecting it from mechanical damage and the harmful effects of stomach acid (mucous keeps acids and enzymes away from the intestinal tissue) and bacterial or viral pathogens.

A relationship with disease?

The presence of mucin and mucous in the intestine appears to be important to the occurrence of disease, also. Mucous reduces the ability of bacteria and viruses to attach to the intestine and also reduces the absorption of toxins produced by these pathogens.

Intestinal mucin contains a large amount of threonine, and the intestine appears to use a large amount of threonine in production of this protein. Dietary deficiency of threonine may reduce the production of mucin, thereby reducing the ability of the intestine to protect itself. Research with pigs also showed that threonine deficiency also resulted in diarrhea.

Digestion of mucin may be poor, because the structure of the carbohydrate inhibits the protein digesting enzymes (proteases) from attacking the protein component of the mucin. Because its digestion is limited, mucin may contribute significantly to the endogenous nitrogen loss from the body.

Endogenous nitrogen loss is the nitrogen found in the feces that is not part of the food intake of the animal. It is comprised of secretions (including mucous and mucin), sloughed cells, enzymes, and other components of the intestine. Under most conditions, nutritionists assume that the amount of endogenous nitrogen lost by an animal is fairly constant. However, it is possible that the amount of

mucin lost may be a function of the diet, particularly if the diet contains components that stimulate mucous production. As a result, the calculated digestibility of the diet may be incorrectly calculated.

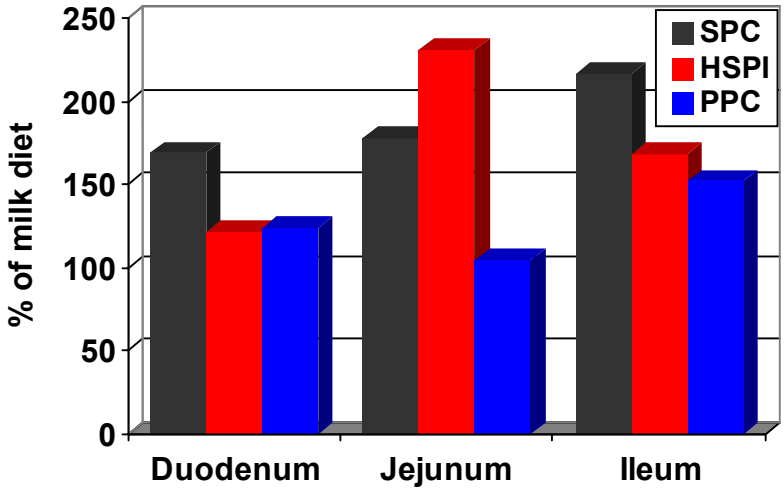

Figure 1. Concentration of mucin in intestinal digesta as a percent of the amount produced by calves fed a control diet containing skim milk powder. From: Montagne et al. (2000).

Differences in mucin production due to diet

Montagne and coworkers at the INRA Research Institute in France used Holstein calves that were fitted with an abomasal catheter and T-cannula in the duodenum, jejunum and ileum. All cannulae were surgically placed in the animals when they reached approximately six weeks of age. Calves were then fed milk replacers containing skim milk powder (Milk), soy protein concentrate (SPC), hydrolyzed soy protein isolate (HSPI), or potato protein concentrate (PPC). The excretion of mucin was increased when calves consumed diets containing alternative proteins, but especially in calves fed SPC. In this case concentration of mucin in digesta was nearly twice that produced by calves fed Milk. Differences were somewhat lower for calves fed HSPI or PPC, although mucin production was still increased.

What does this mean?

The flow of mucin contributes to endogenous loss of protein. Endogenous protein losses result in lower digestibility, increased loss of amino acids (particularly threonine and serine). Poor quality proteins, particularly those containing anti-nutritional factors and fiber, will cause an increase in mucin secretion, thereby reducing overall protein digestibility. From a practical perspective, the use of high quality proteins in calf milk replacers will result in lower mucin secretion and loss and improved overall digestibility.

References

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