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Calf Note #90 – Iron binding antimicrobial proteins

Iron is an essential nutrient for growth. However, free iron in the body may promote the production of free radicals, which can result in tissue damage. Therefore, the body utilizes several different kinds of iron carrying proteins to provide a mechanisms for transporting iron while simultaneously keeping it from causing damage. Iron is also an essential nutrient for many different kinds of bacteria. If iron were removed from the bacterial environment, then growth of the bacteria might be impaired. Indeed, research has been conducted with two different iron binding compounds, lactoferrin and transferrin, to determine if they can contribute to the animal's immune system and possibly replacing AB.

The strategy goes something like this: "if iron is required for growth by some bacteria (like *E. coli*), let's remove the iron from the environment. The growth of bacteria will be decreased".

Lactoferrin (**LF**) is an iron-binding glycoprotein found in milk with a molecular weight of 80 kD. Lactoferrin may have serve as an antimicrobial in the gut of the animal (Arnold et al., 1977; Shin et al., 1998), as a regulator of the immune system (Rejman et al.,1992; Smith and Oliver, 1981). The antimicrobial activities of LF may be especially effective against enteric pathogens such as *E. coli* (Shin et al., 1998) and others (Arnold et al., 1977). In January, 2002, the USDA approved activated lactoferrin as an antimicrobial protein to be applied on fresh meat to reduce the growth of important disease causing pathogens, including *E. coli* O157:H7 (for more information on the use of Lf on meat, go to the web site (http://activatedlactoferrin.com).

Joslin et al. (2002) evaluated the addition of Lf to CMR (and colostrum) in calves housed in individual pens at the University of New Hampshire Experiment Station. Calves were fed 0, 1 or 10 g/d of purified Lf in the milk replacer. Intake of CMR and starter, BW and gain and fecal scores were measured during the 56-day study.

The authors reported improved ADG and starter DMI (Figure 1)

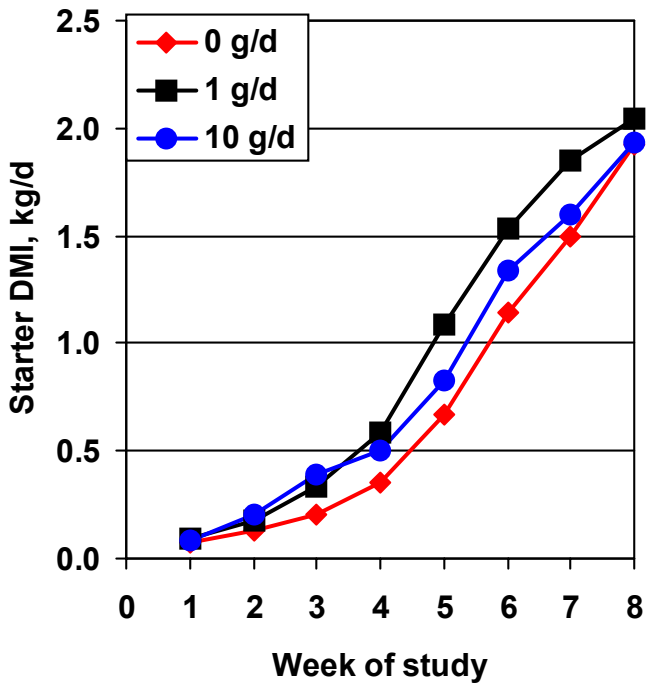

Figure 1. Calf starter intake in calves fed diets containing 0, 1 or 10 g/d of lactoferrin. Adapted from Joslin et al., 2002.

when calves were supplemented with 1 or 10 g of Lf in the CMR. Improvements in BW (Figure 2) and starter intake were particularly evident during the latter weeks of the study. The authors reported that calves were healthier and, consequently, consumed more starter DM, which improved growth.

Although the authors hypothesize that calves were healthier, fecal scores measured during the study did not differ among treatments (2.51, 2.46 and 2.52 on a scale of 1 = normal to 5 = severe diarrhea, respectively) and the number of days the calves had diarrhea (fecal score > 3) also did not differ statistically. The small number of calves in the trial (n = 7 per treatment) may be one reason that the differences in health scores were not statistically significant.

Based on these data, the question of whether Lf can contribute to animal health and potentially reduce the effects of an enteric challenge (i.e., replace AB) have not been completely addressed and more research is required.

Transferrin (**Tf**) is an another iron-binding protein that is found in blood. It performs a similar function in blood as lactoferrin in milk. Transferrin has been proposed as a method of reducing growth of pathogenic bacteria (Brock, 1989; Fettman and Rollin, 1985); however, no on-farm trials have been conducted with Tf in calf milk replacers. In vitro work conducted in our laboratory indicates that apo-Tf can reduce growth of pathogenic bacteria including *Salmonella typhimurium* and *E. coli* by up to 50%. The use of Tf, like the use of Lf, holds some significant promise to reducing the growth of bacteria under certain conditions.

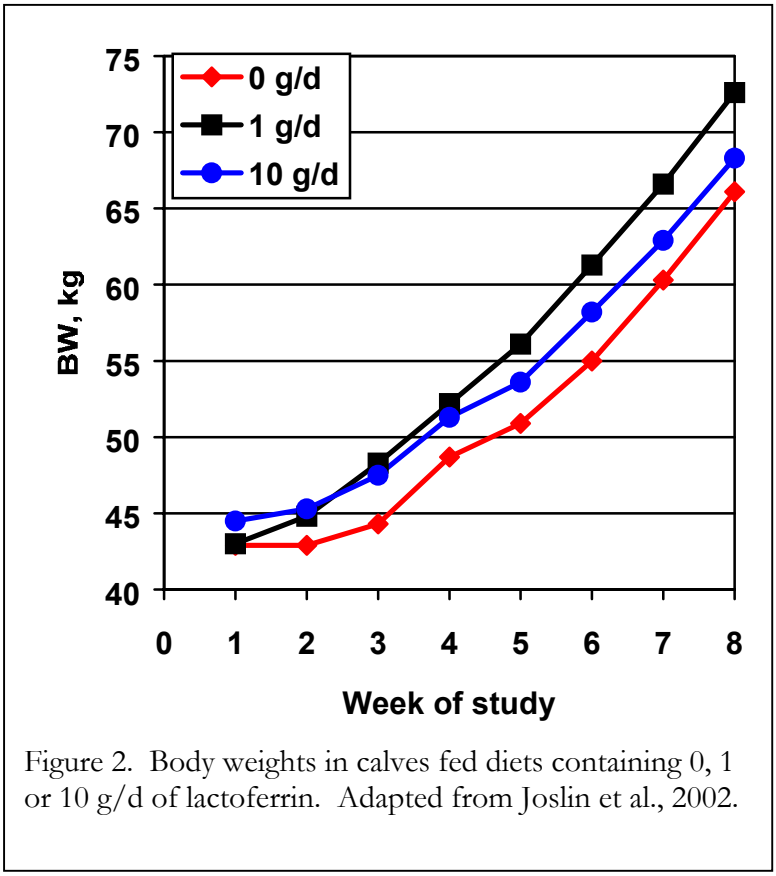

Figure 2. Body weights in calves fed diets containing 0, 1 or 10 g/d of lactoferrin. Adapted from Joslin et al., 2002.

Summary

Replacing antibiotics in animal agriculture requires numerous alternative approaches to reducing the growth of bacteria and virus in the animal. Of course, the most straightforward approach to reducing growth of pathogens is to remove them from the environment in the first place. A clean, stress free environment is the best medicine! But, sometimes animals can be exposed to them – numerous approaches to reducing growth of bacteria and viruses are possible. One approach is the use of iron-binding proteins to remove iron from the environment and impair the growth of bacteria. Interestingly, iron held by the iron carrying proteins does appear to be available to the animal, which means that the animals are not at risk for iron deficiency.

References

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