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Calf Note #52 - Colostrum protein as a source of nutrition for the newborn calf

Introduction

Colostral proteins are an important part of maternal colostrum. The most important and widely understood proteins in colostrum are, of course, immunoglobulins. However, the protein in colostrum is also an important source of nutrients for the calf. Protein in colostrum is utilized by the neonate for protein synthesis in addition to the absorption of Ig. Stimulation of protein metabolism after calving requires large amounts of amino acids. Estimates of protein synthesis by newborn lambs have been reported to be 1.4 g/h per kg of BW (1). Newborn pigs that were fed colostrum had greater protein accretion in the intestine (probably because of Ig absorption) and protein synthesis in visceral organs, brain, lung, and muscle (2, 3). Burrin et al. (2) hypothesized that the intake of colostral growth factors may affect protein synthesis in neonates in addition to the availability of dietary amino acids. More recent work by Swiss workers have shown the importance of colostral growth factors (e.g., IGF-1, epidermal growth factor and other) and hormones (insulin, growth hormone and others) to the initiation of normal digestive function in newborn calves (8, 9, 10).

Colostrum contains many proteins other than Ig. Both ß-lactoglobulin and α-lactalbumin empty rapidly from the abomasum and are readily hydrolyzed to amino acids (1). Casein accumulates in the abomasum and tends to be an important, although more slowly available, source of amino acids. Although Ig are more resistant to degradation, the large mass in colostrum make this protein an important source of amino acids for the neonate. The availability of amino acids for protein synthesis and gluconeogenesis is important in establishing homeostasis.

Calves normally absorb considerable protein during the first 24 h of life. For example, consumption of 3.8 L of colostrum (1 gallon) which contains 150 g/L of crude protein (7) would provide a total of 570 grams of protein. This usually causes a transitory proteinuria. There is significant variation in the amount of protein in colostrum. Research with Jersey cows at the University of Tennessee (7) indicated that colostrum varied from 58 to 202 g of crude protein per liter of colostrum. Calves fed colostrum that is lower in protein may be at greater nutritional risk, particularly when gluconeogenesis is required during the first 24 hours of life.

It is not clear whether modification of the prepartum diet (e.g., with ruminally protected protein or amino acids) would improve energy or protein balance of neonatal calves or improve IgG absorption. Although milk protein production may be increased when cows are fed ruminally protected protein or amino acids, it is not known whether the protein content of colostrum may be improved in this manner. Hook et al. (4) indicated that Holstein heifers fed 13% CP in ration DM did not produce more colostrum or colostrum with more IgG or IgM than heifers fed 9.9% CP although total protein in serum was higher for heifers fed higher CP diets at 1 h postpartum.
Van Saun (5) calculated that the net protein requirements of the conceptus are much greater than current NRC estimates (6) and that current feeding recommendations may lead to depletion of labile

protein reserves in the cow. Further research is needed to evaluate the effects of dietary and undegradable protein on milk and colostral production and protein composition.

In summary, colostrum is a source of protein for amino acids in addition to immunoglobulins. The types and amounts of proteins in colostrum (casein, globulin, albumin) may impact the availability of amino acids needed by the calf for protein synthesis and gluconeogenesis. Therefore, careful consideration should be given to ensuring the proper formulation of the dry cow diet, and additional research is required to better define the parameters that can optimize the protein content of colostrum for newborn calves.

References

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