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Calf Note #54 – Insulin in colostrum

Introduction

Colostrum has traditionally been viewed as a source IgG and not much more. While it is difficult to overstate the importance of antibodies to the newborn calf, scientists are increasingly certain that colostrum is much more than simply a source of antibodies. In fact, colostrum is the first food that the calf consumes and colostral protein, energy (lactose and fat), vitamins and minerals are essential to establish homeostasis, thermoregulation and (of course!) nutrition of the calf.

In addition to antibodies and nutrients, colostrum also contains a tremendous number of biologically active compounds – including hormones, growth factors and others. It's very interesting to note that in many cases, the amount of these compounds is much higher in colostrum than in blood. This means that the cow is actively moving these compounds from the blood into the colostrum. Indeed, cows probably expend considerable effort to "fortify" colostrum with such compounds as IGF-1, growth hormone and insulin. Why cows do this is still not completely clear.

Insulin is a key hormone involved with a myriad of functions in the animal. According to a biochemistry textbook, "In essence, insulin signals the fed state: it stimulates the storage of fuels and the synthesis of proteins in a variety of ways" (2). Insulin stimulates the synthesis of glycogen (carbohydrate storage), increases uptake of glucose by muscle and adipose tissues, promotes the update of branched-chain amino acids by muscle, which promotes muscle tissue synthesis and reduces the catabolism (breakdown) of protein.

Several researchers have looked into the amount of insulin in colostrum. In a paper published in the Journal of Dairy Science (1), Spanish researchers reported on the insulin concentration in colostrum from Holstein cows for three days following calving and then once a week for the next three weeks. Colostrum was transported to the laboratory and then analyzed for insulin concentration using an ELISA assay.

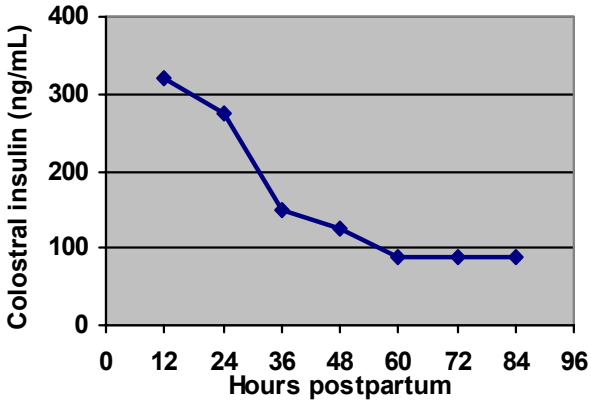

Figure 1. Content of insulin in bovine colostrum. Adapted from Aranda et al.

The amount of insulin in colostrum and transition milk is shown in Figure 1. At 12 hours after birth, the amount of colostrum was greater than 300 ng/ml (nanograms per milliliter of colostrum). The concentration of insulin in colostrum is far higher than the concentration in blood. This means that the cow must have a system to transport insulin

from blood into colostrum.

Researchers in Germany (3) also reported the concentration of insulin in "mammary gland secretions" of cows prior to calving and in colostrum up to six days postpartum. They found that concentrations of insulin in the mammary gland were low until about three weeks prior to calving. As calving approached, the amount of insulin increased dramatically – so that the amount had increased six-fold by two days prior to calving. Following calving the concentration decreased rapidly in a fashion similar to that in Figure 1.

Several researchers have suggested that during the first 24 hours of life, insulin may be absorbed from the intestine and exert effects on the newborn calf. However, Swiss researchers (4) reported that upon feeding insulin to newborn calves there was neither an increase in circulating insulin response nor a lowering of blood glucose level, indicating that insulin was either not absorbed from the intestine or possibly retained in the liver. Other research with pigs (6) does show that insulin is absorbed into the blood. It is quite possible, however, that insulin causes an effect on the intestinal cells that are important in absorbing IgG. For example Shulman (5) reported increased intestinal growth in two day old pigs fed insulin. It is important to remember that the neonatal intestine in one of the most active tissues in the body – and growth factors in colostrum are quite possibly involved with maturation of the intestine, and possibly events such as closure.

The physiological reason for high concentrations of insulin in colostrum remains elusive. However, there is no doubt that the cow purposefully concentrates insulin in the colostrum, presumably to provide a benefit to the calf. This is another fascinating example of the complex interplay between mother and young. Newborn calves rely on colostrum for nutrition, antibodies, and factors such as insulin that influence their survival and growth.

References

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