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Calf Note #81 – Colostrum supplements vs. colostrum replacers

Introduction. We all know the importance of colostrum to the newborn calf. However, there is a real misconception regarding colostrum quality and whether the colostrum you have available is truly suited to feed to the newborn calf. There are many studies (and Calf Notes) related to the variability in colostrum quality. Remember, not all colostrum is the same. Also, not all colostrum is good enough to provide adequate Ig for adequate immune protection.

Since the mid 1980's products have been available on the market called "colostrum supplements" that provide extra IgG to reduce the risk that calves will have failure of passive transfer (**FPT**). These products use IgG from one of three sources – blood, milk/colostrum, or eggs. To date, these three sources are the only places that we can get IgG to use to prevent FPT. As indicated in Calf Note #18, there is a lot of variability in the ability of these products to provide IgG that are truly absorbable. To know how much supplement to use, you must know how much IgG a calf needs.

How much IgG does a calf need? A common recommendation is for calves to receive a minimum of 100 g of IgG in the first 24 h. However, based on calculations, including the apparent efficiency of IgG absorption (**AEA**), this is probably an inadequate amount of colostrum. The AEA from maternal colostrum and many colostrum supplements varies from 20 to 35% (that is, 20 to 35% of the IgG fed can be measured in the plasma at 24 hours after birth), then 100 g of IgG intake will be inadequate for many calves. For example, if a 40-kg (88 lbs.) calf has a plasma volume of 9% of BW, then the expected plasma IgG concentration of a calf consuming 100 g of IgG with an efficiency of 20% is 100 × 20% / 3.6 = 5.6 g/L. Even with AEA of 35%, the predicted IgG concentration of a calf at 24 h of age is only 9.7 g/L. A more adequate recommendation is that calves should consume 103 to 180 g of IgG in the first 24 h of life to reach a minimum of 10 g/L with AEA of 20 to 35%. Prediction of an animal's ability to absorb ingested IgG remains difficult; therefore, it seems prudent to be conservative in estimates of AEA. A recommendation of ingestion of 150 to 200 g of IgG in the first 24 h will reduce the risk of failure of passive transfer in most cases. At 150 g of IgG intake during the first 24 hours, we obtain 150 × 20% / 3.6 = 8.3 g/L. Table 1 has predictions of plasma IgG concentrations at 24 h of age after consuming different amounts of IgG and absorbing the IgG with different efficiencies.

Table 1. Prediction of the plasma IgG (g/L) in 40 kg calves with 9% plasma volume at different IgG intakes and AEA.

	Apparent efficiency of IgG absorption			
IgG intake (g)	**20%**	**25%**	**30%**	**35%**
50	2.8	3.5	4.2	4.9
100	5.6	6.9	8.3	9.7
150	8.3	10.4	12.5	14.6
200	11.1	13.9	16.7	19.4

Clearly, there is a real need for understanding the dynamics of IgG absorption – especially when a colostrum supplement is used. Let's say that you've got four liters of colostrum that is only moderate quality (let's say, 30 g of IgG/L). You plan to feed 2 liters in the first feeding and the

second 2 liters in the second feeding. This means that the calf will get 60 grams of IgG in each feeding. Let's also assume that the calf has a plasma volume of 3.6 liters (40 kg body weight × 9% plasma volume) and the calf absorbs IgG with an AEA of 35% at the first feeding and 17% AEA at the second feeding (net efficiency is 26%). These AEA would be typical if you fed at 1 and 13 hours of age. The predicted amount of IgG in the blood is [(60 × 0.35) + (60 × 0.17)] / 3.6 = 8.7 g/L.

Obviously, this is an inadequate amount of colostrum – the calf will have FPT (< 10 g of IgG/L of plasma or serum) and will be at a greater risk of getting sick and dying. Let's also say that you want to feed a colostrum supplement to increase the number of grams of IgG that the calf receives. If the supplement contains 30 grams of IgG per dose and the AEA of this particular product is 5% (many supplements have a poor AEA!). This would mean that the calculation now becomes: [(60 × 0.35) + (60 × 0.17)] + (30 × 0.05)] / 3.6= 9.1 g/L. The supplement only gives 1.5 g of extra IgG.

Although you spent money and invested time to purchase, mix and feed this particular product, the contribution to the calf was quite minimal. Therefore, it is very important when using colostrum supplements to determine both the dose of IgG as well as the AEA (determined experimentally).

Colostrum supplements versus colostrum replacers. The terms "colostrum supplements" and "colostrum replacers" are poorly defined in the literature and in the industry. Many products that contain relatively little IgG are called "replacers", while supplements may be pretty much anything. I would propose the following definitions. The term "*colostrum supplement*" should refer to those preparations intended to provide < 75 g of IgG/dose and are not formulated to completely replace colostrum. Supplements should be formulated to be fed in conjunction with colostrum and to increase IgG concentration and provide nutrients that are inherently variable in colostrum (e.g., vitamin E).

A *colostrum replacer* must contain an adequate mass of IgG (≥ 75 g of IgG/dose). Why 75 grams per dose? Well, if we need a minimum intake of 150 grams in the first 24 hours of life, then a colostrum replacer, fed in two feedings, must have 75 g in each feeding. Also, replacers must provide nutrients required by the calf. Remember, a colostrum replacer is going to be the only feed the calf gets during this critical period. Energy (as carbohydrate and lipid) is needed to allow the calf to thermoregulate and to establish homeostasis. Digestible protein sources are required as a source of amino acids for gluconeogenesis and protein synthesis, and vitamins and minerals are essential to successful replacer formulation. Colostrum is a highly concentrated source of fat soluble vitamins, as placental transfer of these vitamins is limited. Additional research is also required to define requirements for hormones and growth factors that are found in high concentrations in colostrum. The role of white blood cells in colostrum still needs to be defined.

There is a tremendous need for additional resources to help calf raisers make intelligent decisions regarding colostrum management. It is important that the industry standardize terminology related to these new classes of products. Remember, that replacers (there aren't many on the market today that meet these requirements) won't contain all components of colostrum.

Written by Dr. Jim Quigley (10 February, 2002).

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