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Calf Note #76 – Ig and Biological Safety

Introduction. Colostrum is an important source of nutrition and immune components for newborn calves, lambs, kids, and pigs. We often think of colostrum as a "perfect food" – that is, the single best source of these immune components for newborn calves. Usually, it is. However, there are situations when colostrum may NOT be the best source of IgG for newborn calves. This is particularly true when colostrum might be contaminated with a pathogen that can infect the newborn calf. The purpose of this Calf Note is to provide some background regarding the source and safety of Ig sources for calves.

Where do Ig come from? There are several different types of immunoglobulins in cow colostrum. They are IgG (including IgG_1 and IgG_2), IgM and IgA. The immunoglobulin found in the greatest concentration in cow colostrum is IgG_1. Most experts agree that all of the immunoglobulins found in colostrum are either extracted from the blood of the cow shortly before calving or are produced "locally" by the mammary gland. Generally, blood IgG (particularly IgG_1) is obtained from the cow's blood. IgM and IgA are made locally in the udder.

Changes in plasma concentration in serum of cows around calving.

Ig, g/L	-10 days	Calving	+30 days
IgG	8.2	5.8	11.9
IgM	1.4	1.2	1.2
IgA	0.2	0.3	0.2

Adapted from: Roy, 1991. The Calf, Butterworths, London

As you can see from the table, the concentration of IgG in the blood of the cow is lower at calving than at 10 days prior to calving and at 30 days post-calving. Most experts agree that this indicates loss of blood IgG from the cow to provide IgG to the calf by way of colostrum.

Knowing where IgG come from in the colostrum that we feed to our calves is important as we think about the biological safety and specificity of the Ig we feed to calves. However, if you're considering a colostrum supplement or colostrum replacement product, where do these come from? Well, it depends on the source, but there are four basic sources of IgG in colostrum supplements/replacers:

- Dried colostrum – colostrum is collected from cows, transported to a central facility, processed (sometimes to remove fat, although amount of processing depends on the product), dried and packaged. The majority of the Ig are in the form of IgG_1 with smaller amounts of IgG_2, IgM and IgA.
- Whey proteins – cows normally produce a small amount of Ig in whole milk. These Ig are concentrated during cheese processing and these can be concentrated with further processing. The concentrated Ig are then dried and packaged. The majority of the Ig are in the form of IgG_1 with smaller amounts of IgG_2, IgM and IgA.
- Bovine serum – bovine blood contains significant amounts of Ig. Bovine blood is collected by several companies all over the world. This blood can be processed to remove red blood cells,

fibrin and other components to produce a highly concentrated Ig source. This is usually the least expensive source of Ig, because of the large volumes of blood-derived Ig available. The IgG in serum are approximately equally divided between IgG_1 and IgG_2, with little IgM or IgA.

- Eggs – hens can be hyperimmunized to produce IgY (the avian form of IgG) that is specific against certain pathogens. The eggs are produced, shipped to a processing facility, broken and the eggs are processed. The IgY may be concentrated or the eggs may be spray-dried with little further processing.

Note that all of the sources of Ig – including colostrum – come from animal sources. As of this writing, the only sources of Ig for newborn animals come *from* animals. Further, it is important to recognize that the Ig in blood, milk and colostrum are specific against many different pathogens.

Biological safety. The concept of biological safety (as it relates to colostrum) is especially important when we consider that important production diseases such as Johne's disease or tuberculosis are known to be transmitted by colostrum. More generally, biological safety can be thought of as the relative risk of infecting the newborn with one or more organisms that can cause disease in the material that we feed to calves.

As a producer, you have the responsibility of determining and maintaining the biological safety of colostrum you collect, store, and feed to your calves. This responsibility should not be dismissed. Colostrum is very fragile – it is easily contaminated (or may be contaminated by the cow) and it is a perfect medium for microbial growth. Because the composition of colostrum is so different from whole milk, it is very easily contaminated and microbial growth occurs very quickly. Determining the degree of contamination is difficult, also. It is better to start with clean colostrum and keep it that way than to try to process infected colostrum to "clean it up".

Biological safety of colostrum supplements & replacers depends on the source of the Ig (and inherent risk of contamination), the methods of processing, storage and application on the farm. None of these sources is inherently more or less safe. All have risks – but the risks are no more (and may be significantly less) than using colostrum from the farm. Further, all dried colostrum supplements and replacers are exposed to some form of "kill step" (including drying) that reduces the microbial load in the products.

Some suggestions to maximize the biological safety of colostrum, colostrum supplements and replacers:

- Collect colostrum from cows known to be healthy. This is especially important in herds with Johne's and other disease problems. A testing program for infected cattle can reduce the risk of transmission of disease through colostrum
- Sanitize the udder prior to collecting colostrum – use the same methods that you would use for collecting milk. Dirty colostrum can be a significant source of disease-causing pathogens on many dairy farms
- Collect colostrum into a clean, sanitized container used ONLY for the purpose of collecting colostrum
- Do not allow colostrum to sit at room temperature. If you are not feeding colostrum, you should keep it frozen or refrigerated

- Colostrum supplements should be handled carefully – store according to label directions. Generally, they should be kept dry and cool.
- Use clean water or colostrum to rehydrate colostrum supplements or replacers.
- Once a supplement or replacer has been mixed with water or colostrum, it should be used immediately. Do not store this material unless instructions for doing so are provided on the label.

Specificity. This refers to the ability of the Ig absorbed into the calf to have activity against the pathogens to which the calf might be exposed. Specificity is an important concept, because all Ig are specific for a particular antigen. If the calf consumes 100 grams of IgG, but the IgG are not specific for the viruses and bacteria in the calf's environment, then the calf is not protected and will get sick.

In the "good old days", calves were born and stayed on the same farm for their entire lives. Therefore, the Ig produced by the cow and put into colostrum was an excellent method of transferring the "immunological history" of the farm from the cow to the calf. The Ig produced by the cow are specific for the antigens to which the calf might be exposed during the first few weeks of life. In this case, colostrum from the mother – or another cow on the same farm – would give the calf the best profile of Ig to protect it against the pathogens that it's likely to see on the farm.

Today, it's common for calves to move many times during its life – and sometimes within the first day or two of birth. Therefore, the transfer of IgG from cow to calf might not be as important if the "antigenic profile" (the types of pathogens in the environment) of the new farm is different from that of the old farm. However, this is a difficult concept to determine on the farm. So, it is probably best to provide a large mass of IgG that is specific for a wide variety of pathogens.

What about the specificity of colostrum supplements? Colostrum supplements derived from blood, milk and colostrum should have a very wide specificity, which would provide protection against a large number of potential pathogens. Large volumes of the raw materials (in most cases, >20,000 kg) are collected and pooled before processing. This effectively broaden the profile of IgG in these products. On the other hand, egg-derived IgG will tend to be more targeted against a specific pathogen, since the birds are typically hyperimmunized.

Summary. Colostrum, while it is an important source of IgG, is not the "perfect food". It is important that producers consider not only colostrum quality (IgG content), but also the Ig specificity and biological safety of colostrum. Handling colostrum to minimize the risk of contamination, collecting colostrum from healthy cows, and storing to minimize spoilage are critical. Colostrum supplements and replacers should also be exposed to the same scrutiny. Colostrum products should be evaluated for the amount of IgG available, the specificity of its source and the relative risk associated with the product.