Milk Replacers: Understanding Protein Formulation

Andre Roy, Grober, Inc

There are 2 major milk-based sources of proteins that are typically used to manufacture milk replacers: skimmed milk powder or whey. Skimmed milk is obtained when the milk fat is removed from whole milk. The skimmed milk is then dried into skimmed milk powder (SMP). SMP is made of 80% casein and 20% whey proteins (globulin and albumin). Whey proteins are obtained after the production of cheese. When making cheese, the milk is coagulated with rennet or other enzymes, which precipitate all the casein protein into the cheese and the whey proteins are left out in a liquid form. The liquid whey can be dried to obtain a 12% protein (DM) powder or the lactose can be removed through ultrafiltration to obtain WPC (whey protein concentrate) with 34 to 80% protein. The later products are often used in ice creams, chocolate bars or cereals and will appear as modified milk ingredients.

Why do we make the difference between these 2 basic milk protein sources? It’s because of how they are digested in calves. Just like whole milk, SMP coagulates in the abomasums of the calf. Once the curd is formed, it is slowly released into the intestine and thereafter digested. On the other hand, whey proteins cannot coagulate anymore and therefore are released into the intestine soon after intake for digestion. The same rennet that is used to make the cheese curds is present in calves and triggers (along with chimosin and hydrochloric acid) the coagulation of the casein present in SMP.

Several trials were done over the years to compare the performance of calves fed milk replacers based on SMP versus whey proteins, and also to measure the digestibility of these proteins. The digestibility of both sources of protein varied between 90 and 95%, while the overall performance would always be comparable over the 6 to 8 weeks period trials (Terosky et al, 1997; Lammers et al, 1998). When the skimmed based milk replacer is made of high quality (not-denatured) SMP, clotting will happen naturally and provide an excellent source of nutrients to the calf. One would expect these results since SMP is naturally closer to whole milk as only the fat content was removed. On the other hand, SMP based milk replacers have been researched at length for its need to coagulate for proper absorption.

Any difference in performance between skimmed and whey protein-based milk replacers was sometimes observed within the first 2 weeks of age. Calves up to that age are more sensitive to getting scours - either of bacterial or nutritional. In the mid 1950’s, milk replacers that incorporated SMP into the formula could cause scours and reduced performance during this critical first 2 weeks. This was due to the incorporation of poor quality or heat-damaged SMP. The heat-damaged powders had diminished clotting attributes. With improved technology and equipment, the SMP produced today is of high quality.

Grober ensures the quality of the SMP through several QA criteria in Grober’s laboratory, including coagulating ability. Proper care has to be taken in the manufacturing of SMP based milk replacers to reduce the possibility of scours and hence,
poor performance. Since we have already been using SMP extensively to manufacture milk-fed veal milk replacers, first in finisher diets, then in starter diets, we have been incorporating additives to help Mother Nature in getting the SMP to form a clot and provide proper digestion. With the addition of the appropriate type and quantity of coagulating salts, and through mild acidification, the newly formulated milk replacers will provide similar performance than previous.

REDUCING INCIDENCE OF SCOURS THROUGH PROPER NUTRITION AND MANAGEMENT

1. Colostrum feeding and management. Feed proper quantity on a timely manner. Ensure proper handling of both colostrum and feeding equipment to reduce bacterial growth.

2. Prepare the milk replacer as recommended on the label and on a consistent basis. Take the time to verify that the proper volume/weight ratio of powder is used. Measure the temperature of the milk at feeding. Variations of more than 2°C can cause digestive upsets.

3. Feed the milk at consistent hours, as evenly separated as possible. It is a long time to be out of nutrients for a newborn calf if not fed between 5:00 PM and 8:00 AM.

4. The high performing milk replacer program involves feeding elevated levels of a higher protein milk replacer. Both of these changes can put more pressure on the smaller newborn calves. One can expect thinner manure than what is often considered as normal. BUT this is not a scour.

5. Feeding of whey or skim based milk replacers do not influence water feeding management. As long as the water is fed at least 15 minutes after milk feeding, the water will go to the rumen and help its development as the calf digests grains.

6. Some dairy producers feed 3 times a day for the first couple of weeks, particularly those on the high performing programs. Even if skimmed based milk replacers take longer to digest, only the clot portion (20-30% of DM fed) stays behind in the abomasum and get released over a 4 to 6 hours period. The rest of DM is almost all completely released within 2 hours. Therefore, as long as there is an interval of 4 hours, preferably 6 hours between feedings; these newly formulated milk replacers will not create an overload to the calf.

7. For those feeding calves with “machines”, it is still important to offer a minimum of 2 litres per allotment and otherwise, no changes will be necessary on the feeding schedule.