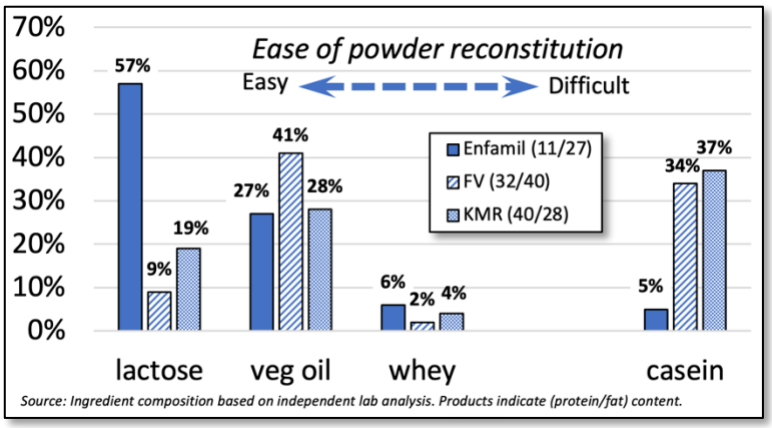
Milk Powders for Human Babies and Other Mammals Reconstitute Differently

People familiar with preparing powdered infant milk formula (IF) for human babies often expect other milk powders to mix the same – quickly and easily. However, livestock and domestic pet milk replacers (MRs) used with animal species are very different. Differences include: their intended use (including species), product design, nutritional formulations, and processing methods. All of these factors directly affect powder reconstitution characteristics and efficiency. This article identifies and explains one of the major obstacles which is **casein protein reconstitution**. It also provides links to other resources that provide some easy steps used in formula preparation to overcome these hurdles. Following these steps results in a more completely reconstituted, nutritious and digestible substitute wildlife milk formula.

Why is casein an issue?

Let's start with a quick review of common ingredients used in powdered milk products: skim or nonfat milk, vegetable oil (added in since the butterfat has been removed), lactose, milk proteins (casein and whey), and vitamin and mineral supplements. Lactose, vegetable oil and whey proteins reconstitute quickly and completely. However, casein proteins reconstitute more slowly. This is due to several factors that include a complex molecular structure, as well as transformations that take place during milk processing and the drying process. It is essential that they are effectively reconstituted to be able to be digested and utilized in the GI tract. The complex casein molecules contain many vital proteins and minerals (i.e., calcium and phosphorus). With key nutritional and biological properties, they affect development, growth and health in the short-term, as well as long-term.

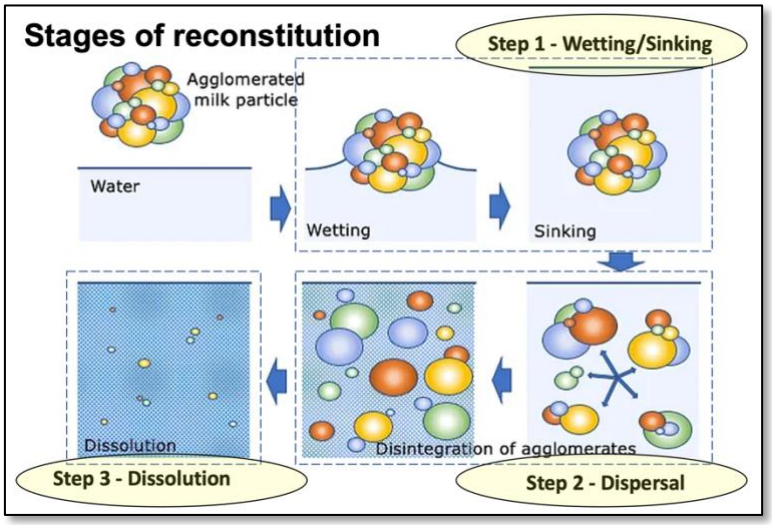


Consider the accompanying chart that compares the primary ingredients between a popular IF (Enfamil®) and two commonly used MR's (FoxValley 32/40 and KMR®). It is quickly apparent that the IF has 6x the amount of lactose (easily dissolved sugars) than casein, while the MR's have about 7x the amount of casein (difficult to reconstitute) than lactose. Those differences alone account for much of the superior reconstitution of IF's over MR's.

Other factors that contribute to the ease of IF reconstitution include: the use of high quality, food grade ingredients; extensive industry research and development targeted to constant improvements in human IF formulations and manufacturing (including certain lactose-coating of casein proteins to enhance reconstitution); and added attention to packaging with a shorter shelf life (≈18 months vs 24 months for most MRs).

MR product directions basically say to 'mix, stir and feed.' Why doesn't that work?

Any powdered milk product must undergo the documented stages of reconstitution during its preparation prior to feeding. Otherwise, it will likely still contain residual dry powder, which is unsuitable for feeding. The accompanying diagram depicts these stages of taking a dry milk particle through the process to final hydration. Most IF products with low concentration of casein (≈5%) progress through these steps very quickly and are generally considered 'instant mix' products. Conversely, since the MR's can have a 7x higher casein content, they progress much more slowly



through the stages. Many manufacturers market the products as 'instant mix.' as they likely believe consumers expect and want easy and fast preparation. Fortunately, at each of the 3 required stages, steps can be taken to improve casein reconstitution as follows (and are further discussed and demonstrated on the Mixing Guide page):

Step 1 – Wetting and sinking. High casein content powders generally form a surface film as the dry milk particles contact the water, often inhibiting wetting and sinking of the powder. Studies show best performance using ≈ 110-120°F water and allowing 5 minutes to wet and sink in order to minimize development of the surface film. Some MR powders will completely sink, whereas other powders may still partially float on the surface. Another simple step to promote wetting and sinking is to increase the surface area where the powder comes into contact with the water. This can be easily done by using a larger diameter mixing container to allow more of the powder to spread over a larger surface area of the water.

Step 2 – Dispersal. Since the powder must become fully wet prior to full hydration/reconstitution, any powder that remains floating must be pushed below the surface to assist with wetting. A hand whisk can accomplish this, and also serves well to then mix the powder in the water. Studies show the best water temperature is still in the ≈ 110-120°F range, and that slow mixing speeds are ideal (around ≈ 100-200 rpm, or brisk hand whisking). Interestingly, faster speeds (i.e., high speed mixers, immersion blenders) can cause clumping that works against desired dispersal.

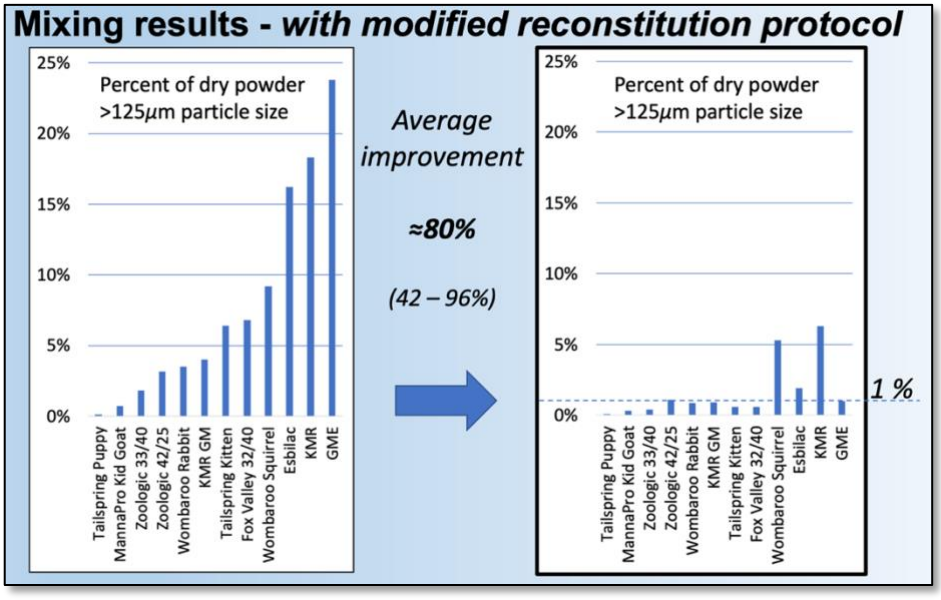
Step 3 – Dissolution. Studies show that dissolution (hydration) of larger casein powder particles only begins to occur at around 30 minutes and continues over the next several hours. WildAgain's testing suggests best results after about an 8-hour resting period in the refrigerator at 40°F.

Storage conditions of powdered MR can also impact reconstitution.

Unknown to many users, casein solubility is also affected by *storage time and temperature* of milk powders. One published study showed that solubility (dissolution) of casein can decrease quickly when MR's are stored unopened at higher temperatures. Even at only 2 months after manufacture, the study indicated that the solubility reduced 90% when stored at 95°F and decreased 50% at 86°F. While there was no initial decline during 2 months when stored at room temperature (68°F), after 7 months of unopened storage at room temperature, solubility showed a 50% drop. This suggests that storing at refrigerator (40°F) or freezer (0°F) temperatures will slow the decline in solubility, though this was not specifically tested in the study. Therefore, buying any of the MR products as fresh as possible is preferred, since longer storage time can interfere with solubility.

Why is milk powder and casein reconstitution so important?

Unlike the 'instant-mix' IF products, the MR products require additional special handling. As mentioned previously, incomplete reconstitution will result in feeding dry powder to young animals with developing GI systems. This can lead to digestive issues and compromise animal health, growth, and development. Additionally, 2/3 of the calcium and phosphorus in milk is bound up in the casein molecule as calcium phosphate and requires full hydration to be accessible. The easy-to-follow steps outlined in the Mixing Guide and accompanying videos can result in an average of ≈ 80% improvement in solubility (ranging from 42% - 96% depending on specific MR product) as shown in the accompanying set of charts.



Resources

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