Milk Powders for Human Babies and Other Mammals Reconstitute Differently!

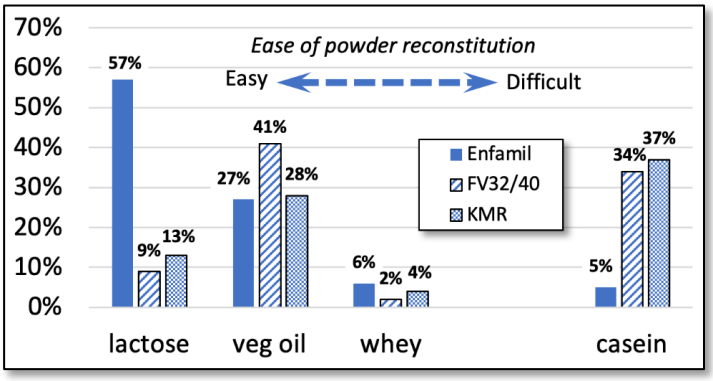
By Allan Casey

People familiar with preparing powdered infant milk formula (IF) for human babies often expect other milk powders to mix the same – quickly and easily. Livestock and domestic pet milk replacers (MRs) used with other species are very different. Differences include their intended use (including species); product design; nutritional formulations; and processing methods – all of which directly affect powder reconstitution characteristics and efficiency. This article identifies and explains of one of the major obstacles: casein protein reconstitution. It also provides links to 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 (fat replacement since the butterfat has been removed); lactose; milk proteins (casein and whey); and vitamin and mineral supplements. Lactose, vegetable oil and whey proteins reconstitute relatively quickly and completely. However, casein proteins reconstitute more slowly. This is due to several factors, including 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 and able to be digested and utilized in the GI tract. The complex casein molecule contains many vital proteins and minerals, including calcium and phosphorus. These key nutrition and biological properties affect development, growth and health in both the short-term and long-term.

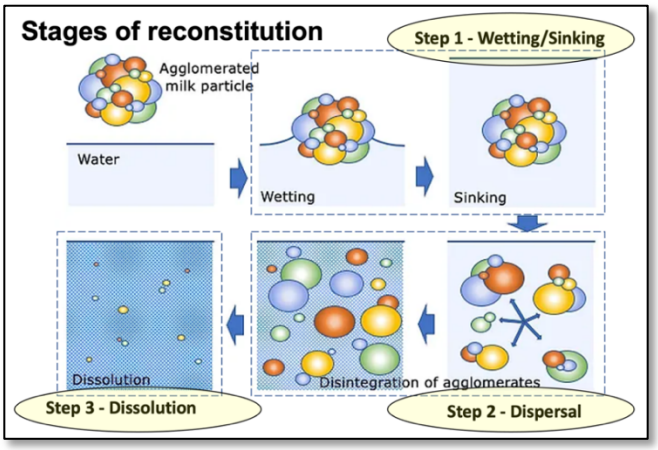
Consider the accompanying chart that compares the primary ingredients between a popular IF (Enfamil®) and two commonly used MRs (FoxValley 32/40 and KMR®). It is quickly apparent that the IF has 6x the amount of lactose which is easier to reconstitute than casein. Conversely, the MRs have about 7x the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



Other factors that contribute to IF reconstitution include: (1) the use of high quality, food grade ingredients, (2) extensive industry research and development targeted to constant improvement in human IF formulations and manufacturing (including certain lactose-coating of casein proteins to enhance reconstitution), and (3) 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 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. Many manufacturers market the products as 'instant mix' because they likely believe consumers expect 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, which inhibits wetting and sinking of the powder. Studies show best performance using ≈ 120-130°F water and allowing 5 minutes to wet

and sink to minimize the surface film. Some powders will completely sink, while others may still float on the surface. Another simple step to support wetting and sinking is to increase the surface area where the powder comes into contact with the water. This is easily done by using a larger diameter mixing container where the powder is spread over a larger surface area of the water.

Step 2 – Dispersal. Since the powder must get fully wet prior to full hydration/reconstitution, any powder that is still floating must be pushed below the surface to assist with wetting. A hand whisk works well and also serves to mix the powder into the water. Studies show the best water temperature is still in the ≈ 120-130°F range, and that slower mixing speeds work better (around ≈ 100-200 rpm, or brisk hand whisking). Interestingly, faster speeds (i.e., high speed mixers or immersion blenders) can cause clumping that works against the desired dispersal.

Step 3 – Dissolution. Studies show that dissolution (hydration) of larger casein powder particles only starts at around 30 minutes and continues over hours. WildAgain's testing suggests best results after about an 8-hour resting period in the refrigerator at 40°F. Many users are unaware that casein solubility is also affected by storage time and temperature. One published study showed that solubility (dissolution) of casein can quickly be negatively impacted and decline when the powder is stored unopened at higher temperatures. Even at only 2 months after manufacture, the study indicated the solubility reduced 90% when stored at 95°F and decreased 50% at 86°F. While there was no initial decline 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. Buying any of the MR products as fresh as possible is preferred since longer storage time interferes 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, risking the development of digestive issues and compromising animal health, growth and development. Additionally, 2/3 of the calcium and phosphorus in milk is bound up in the casein molecule and therefore requires full hydration. The easy-to-follow steps outlined in the Mixing Guide and accompanying videos can result in an average of ≈ 80% improvement in reducing undissolved dry powder. This improvement showed a range from 42% - 96% depending on specific MR product as shown in the accompanying set of charts and videos at https://www.ewildagain.org/formula-mixing-guide

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