

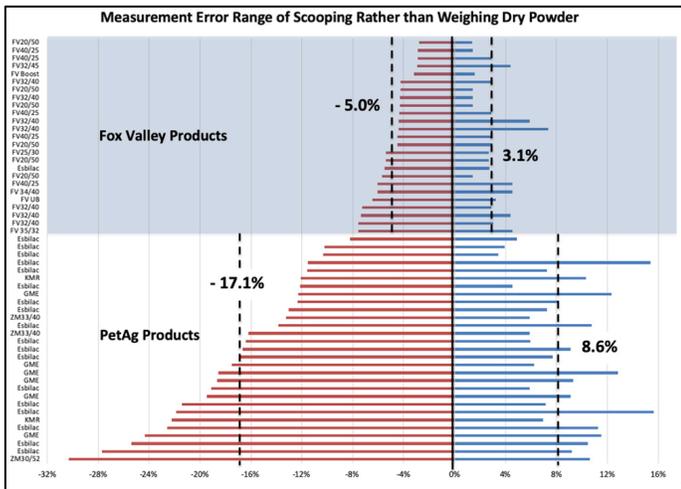
**INCREASING BIOAVAILABILITY OF NUTRIENTS IN POWDERED MILK FORMULAS BY 5 to 15+ %**

By Allan Casey

Bioavailability is defined as that “...portion of a substance which enters the circulation when introduced into the body and so is able to have an active effect” for the purposes of this article. Starting with a stabilized and hydrated animal, many factors can adversely affect the actual amount of nutrients delivered to the animal when using powdered milk replacers. These include but are not limited to: formulating an incorrect recipe that does not proportionately match mother’s milk; using products that fail to meet guaranteed minimums of proteins, fats and minerals; having a lower quality of ingredients that can affect digestibility; and using a feeding regime ill-matched to the age, condition and needs of the animal. Some of these factors are more easily corrected and controlled than others.

One of the more significant negative issues, and one most easily corrected, is error introduced when measuring the dry powder by volume using a scoop. Our tests have shown that this variability can range in scooping less volume than intended - by as much as 5-10%, or even more. **Simple math suggests that the bioavailability of that volume shortfall is exactly zero.**

Consider the following chart, which shows over 50 individual lots from products manufactured by Fox Valley and PetAg® involving 2,500 individual (US)TBSP scoops and weights:



The chart above shows extreme low and high measurements. These variabilities can and do happen - especially when the rehabilitator is rushed, distracted or new to the task. Another observation from the chart is that if scooping error does occur, it is twice as pronounced on the downside (under-scooping) versus over-scooping. Why is that?

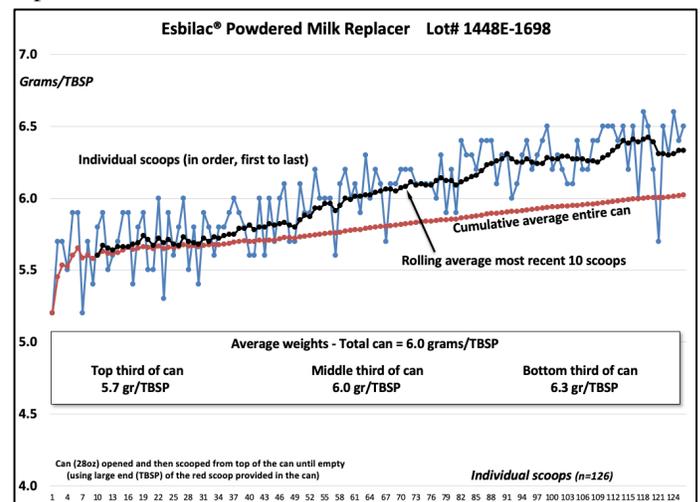
Setting aside each person’s unique scooping ability and technique, it has to do with the physical characteristics of the powdered products themselves and how they are made. While each manufacturer’s process is different and proprietary, we can offer informed judgements as to how the

products are made. Most powdered milk products (bovine) are made from the whole skimmed milk after the cream and butterfat have been removed. The remaining milk is then further separated. Various components (casein, whey, lactose, etc.) are left in liquid form or dried, and then formulated into the final product to be sold. Fox Valley Animal Nutrition explains that they combine dried ingredients into a final product, with a fine granular texture (example below left). On the other hand, PetAg® combines ingredients and then uses a spray dry agglomeration process that yields a lighter, more fluffy and sticky product (below right). These different methods produce powders with different reconstitution properties.



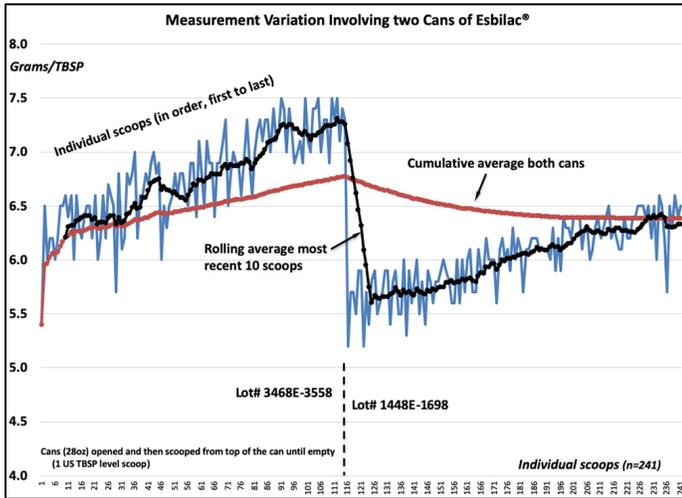
The differences in physical structure introduce different handling characteristics when scooped by volume to measure out a desired quantity. Not surprisingly, the agglomeration process results in more air in and around the PetAg® powder particles. They are about twice the average particle size (170-200µm) versus Fox Valley (110µm), as measured by recent lab tests. With more air, fluffiness and stickiness, scooping PetAg® products will also ‘scoop’ more of this void area and tend to produce under-weighted measures. This results in a risk of underfeeding an animal versus the amount of formula intended.

The PetAg® products produce fairly consistent and repeatable measurement error as shown below:

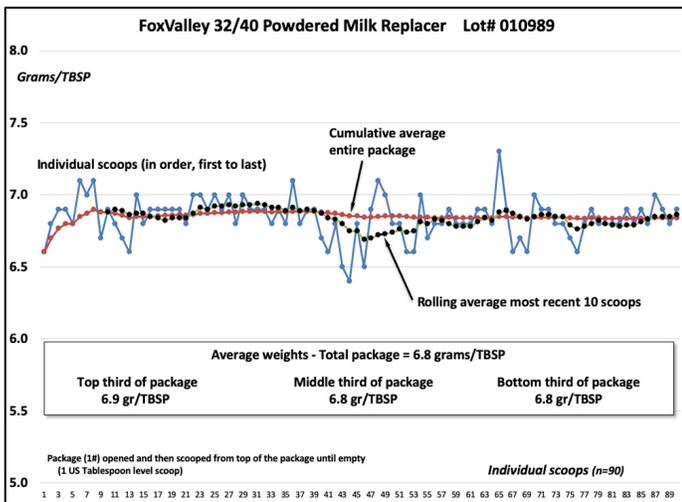


The average weight of powder in this lot is 6.0 grams/(US) TBSP. However, this single 28oz. can produced individual scoops weighing from 5.2 to 6.6 grams, representing a 1.4 gram difference. Additionally, those low and high samples represent a -13% to +10% variance. The “compaction” effect is clearly evident, in that as the powder is scooped from top to bottom, it compacts any powder underneath, resulting in measurably more dense powder in the bottom half of the can.

The variability in a single can is compounded when a can is emptied and a new one opened. As shown in the next chart, it is possible that the final TBSP scoop of the first can is 7.5 grams and the first scoop of the next can could be as low as 5.2 grams. That represents a 30% drop in milk powder in a single and successive scoop from one can to another. The pattern of low to high scoops and compaction repeat again.



The finer, granular texture of Fox Valley products produce less variability when scooping by volume (on average about 50% less). The following chart shows the compaction effect seen in PetAg products is not present, as the average weight of a scoop is essentially the same in either third of the package.



The easiest way to totally eliminate this type of measurement error is to switch to weighing the powder (and other ingredients) rather than simply scooping by volume. This costs about \$20 for a gram kitchen scale and a little extra time. A new feature of the Nutrition Calculator at ewildagain.org converts the chosen recipes in *parts* to *weights* (for any given volume of desired formula). It's that simple to boost nutrient

bioavailability of the formula by eliminating the deficit caused by scooping. It is good to have a gram scale anyway in order to weigh young animals to determine feeding amounts and monitor weight gain. The scale shown is pocket sized, weighs up to 500 grams with a .01 gram precision, and has a tare function to easily net-out the weight of a container. It costs about \$10 from online retailers.

If weighing is simply not an option, here are some suggestions to minimize error when using volume measurements:

- 1.) Focus on the task at hand. Slow down and try to be as precise and consistent between scoops as possible.
- 2.) Use a scooping measuring vessel (tablespoon, ½ cup, cup, etc.) with a smooth and level rim. Level off using the back of a table knife.
- 3.) Have a single person perform the dry measures. When multiple users are required, discuss consistent protocols.
- 4.) To minimize the effects of compaction, consider rolling the can/reshuffling the bag to redistribute the powder that may have settled during shipment, storage, or scooping.
- 5.) Use room powder that has been allowed to attain room temperature. (Store dry powder at or below 40°F.)

In summary, consider weighing the ingredients. The free calculator at ewildagain.org does the math and provides the exact weights for each ingredient. Remember, if you measure by volume and you inadvertently under-scooped the desired amount 5-15%, ***the missing nutrients are not in the prepared formula and will never be bioavailable!!*** Breaking established habits is hard, but this is an easy fix!

*Allan Casey, is a licensed wildlife rehabilitator in Evergreen, CO and co-founder of WildAgain Wildlife Rehabilitation, Inc. Ewildagain.org contains a longer version of this article. More charts and full discussion of their recent lab tests and research of over 150 products/lots of milk replacers.*

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### Should I also use weights to construct formula recipes?

You can, but here is an easier method. The Nutrition Calculator downloadable from ewildagain.org allows you to construct a recipe in *parts* and then it automatically converts and displays the corresponding *weights* of the ingredients in grams. That allows you to more intuitively formulate your recipe in parts (the way most of us think about this), and then the Calculator does the math for you to get to gram weights for your desired formula volume (1/2 cup, cup, quart, etc.). You then simply weigh the displayed amounts for each ingredient and combine to get your liquid substitute milk formula.

