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Calf Note #235 – Milk replacer mixing – "into or onto"

Introduction

During a recent conversation with some calf raisers about milk replacer mixing and how to ensure mixing is consistent every day. One producer commented on the need to remind workers about the difference between mixing milk replacer "into" water or "onto" water and how it affects the ultimate mixing

A quick review

We strive to provide calves with the right amount of nutrition in CMR by selecting the amount (weight) of CMR powder added to an amount (weight or volume) of water to make a mixture. Quantities of CMR and water vary by age of calf and farm goals. Typically, however, the concentration of the final mixture should range between about 12% solids and 17% solids, depending on the composition of the CMR, resulting osmolality, season, availability of water, and other factors.

So, what's the "into" and "onto" all about when it comes to mixing CMR? Well, it's a bit of shorthand for whether we add CMR powder to achieve a known final volume (i.e., "into") or was add the CMR to the volume we want (i.e., "onto"). Here's an example.

A caveat

I make a number of assumptions and simplifications in these calculations. For example, the specific gravity of water varies slightly by temperature, so to be completely accurate, we should perform these calculations at a known temperature and adjust the specific gravity of water. In my examples, I'm assuming that 1 milliliter of water = 1 gram, which is true at 4°C. Also, the increase in volume of the reconstituted mixture (the displacement) varies depending on the composition. A simple table for calculating displacement is in Table 1 for a CMR containing 95% DM, 25% crude protein, 18% fat, and 7% ash, with the remainder assumed to be lactose. The displacement is estimated to be about 0.76, though this value will vary slightly depending on methods of manufacturing, temperature, etc. However, I did not attempt to account for these differences.

Table 1. Calculating displacement.

Nutrient	%	Factor	Total
Water	5%	1.00	0.05
Protein	25%	1.50	0.38
Fat	18%	0.60	0.11
Ash	7%	0.00	0.00
Lactose	45%	0.51	0.23
		Displacement	0.76

"Into"

In this example, we wish to feed our calves 750 grams of CMR powder and make 5 liters of reconstituted mixture. So, we'll put CMR "into" the water to make our 5 liters of reconstituted CMR. In table 2, you can see that we use 750 grams of CMR powder to begin. We adjust the weight of the CMR for its displacement

(0.76) to make an estimate of the volume contribution of the powder. Then, we take 5,000 – the CMR volume to equal the amount of water minus the displacement to calculate the amount of water we'll add. In this example, it's 4,457 milliliters.

The percent solids is calculated on the bottom row of the table. The concentration of the mixture on a total grams basis (i.e., as-fed basis) was 14.4%. This is the calculation of solids on a weight basis (i.e., weight/weight, or w/w), but not corrected for the water content of the CMR. The second column calculates the percent solids (w/w) on a DM basis. Finally, the last column is the percent solids on a volume basis (w/v), corrected for the moisture in the CMR. This is the value we're most familiar using. Note that the percent solids w/w is very similar to w/v. This is common in calculating percent solids, but may vary depending on the composition of CMR. It's best to calculate the percent solids. I've included a simple Excel calculator to assist in conducting the calculations. [You can find it here](#).

Table 2. Example of mixing CMR "into" water.

Ingredient	Liters	Grams	Total Grams	Solids Grams	Solids Liters
Water	4,457		4,457	0	4,457
CMR		750	750	713	543
Total	4,457	750	5,207	713	5,000
		Percent solids:	14.4%	13.7%	14.3%

"Onto"

Another approach is to start with the ending volume in mind – i.e., 5 liters. Table 3 shows the calculations. In this case, however, we start with 5 liters of water and add "onto" that volume the 750 grams of CMR powder that we want to feed. The net result is a final volume of 5,543 milliliters of reconstituted CMR with a percent solids (w/v) of 12.9%. Percent solids on a w/w on a DM basis was equal to 12.4%

Table 3. Example of mixing CMR "onto" water.

Ingredient	Liters	Grams	Total Grams	Solids Grams	Solids Liters
Water	5,000		5,000	0	5,000
CMR		750	750	713	543
Total	5,000	750	5,750	713	5,543
		Percent solids:	13.0%	12.4%	12.9%

Solids concentration differences

The primary difference between the two approaches is the amount of water included in the mixture and the final solids concentration. In both cases, we are offering the calves 750 grams of CMR per day, so the amount of nutrition available to the calf isn't different between mixing approaches. The difference lies in the solids concentration and volume of water. In the first example, we will feed 5 liters of reconstituted CMR with a solids concentration of 14.3% w/v. In our second example, we feed the calf 5,543 ml of CMR with a concentration of 12.9%. Variation in volumes and concentration may affect the health and growth of calves, so changing how milk is mixed should be discouraged.

Summary

How CMR is mixed on the farm should be clearly defined – best with a written protocol – and consistently done at every feeding. If applied consistently, either approach is satisfactory, though the differences in final solids concentration should be carefully evaluated. However, more important is not switching from one method to the other, which can introduce variation in feed offered to the calves, which may impair performance. For more information on how CMR variation can affect performance, see Calf Note #150 – Consistency in milk feeding.

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