Adding milk replacer to pasteurized whole milk

Al Kertz, PhD, PAS, DIPL ACAN
ANDHIL LLC
St. Louis, MO 63122
andhil@swbell.net
www.andhil.com

Calves are babies and like human babies they like consistency. The problem is with calves, you may not know they are not doing as well or know why. So, consistency, especially in liquid feeding, is paramount. Factors contributing to inconsistency in liquid feeding include feeding waste milk which varies in composition and volume available, varying the % solids in milk replacer (MR) mixing and feeding, and adding MR to milk to feed more solids but without varying volume fed. If a dairy or calf operation cannot get enough solids fed to calves with twice daily of 12-13% solids MR fed, and does not want to add a third feeding, then it is tempting to add MR to the milk or MR with solids up to 16-18%. That is a huge red flag as now the osmolality of that mix is much greater than milk. That can create digestive upsets and even sudden deaths (Kertz and Loften 2013). With this as background, a calf study was done on an Iranian commercial dairy farm (Fouladi et al., 2024).

First, I want to commend the authors for describing the calf starter in the title. Unfortunately, too many calf studies do not even provide a good description of the starter in the text. On the other hand, the starter in this study is poor. I prefer and calves do better both prior to and after weaning when fed a well-texturized starter (Kertz 2019). On the liquid feeding side, the amount of liquid fed in the US increased from an average of 4 quarts daily to 6 quarts (50% increase!) from 2007 to 2014, These NAHMS studies also found a one week increase in age at weaning from 8 to 9 weeks. We have made much more progress in liquid feeding than in the quality of starters fed.

Forty-five Holstein calves were removed from their dams immediately after birth, weighed, and placed in a clean individual pen bedded with fresh wheat straw. Calves were then fed 6 liters of good-quality maternal colostrum (≥ 22% Brix values) in 2 equal meals using nipple bottles within 6 hours of birth. Calves were screened for serum total protein concentration (6.4 ± 0.58 g/dL) as a condition for trial enrollment. Forty-five calves that appeared healthy and had a serum protein concentration >6 g/dL (24 females and 21 males; 87.6 ± lb body weight) were included in the study.

After colostrum feeding, calves were fed 4 liters of transition milk on day 2 of life. From day 3 onward, calves were transferred to outdoor individual pens (2 × 1.1 meters) bedded with sawdust. Calves were blocked by sex, balanced for BW, and randomly allocated to 1 of 3 dietary treatments (n = 15 calves, 8 female and 7 male calves per treatment).

The 3 treatments were 1) conventional 1.27 lb daily from days 3–56, and 0.63 lb daily from day 57–59 of age (CONV; solids intake = 70.2 lb), 2) short duration of adding MR to milk, 1.27 lb daily from day 3–9, 2 lb daily from day 10–41 milk + MR, 1.27 lb daily milk from day 42–56, and 0.63 lb daily milk from day 57–59 (solids intake = 93.1 lb, 3) long duration of adding MR to milk, 1.25 lb daily milk from day 3–9, 2 lb daily milk + MR from day 10–56, 1 lb daily milk +

MR from day 57–59 (solids intake = 105 lb). Pasteurized whole milk containing 3.27 ± 0.21% fat, 3.14 ± 0.11% CP, 4.79 ± 0.05% lactose, and 11.5 ± 0.21% TS was warmed to 39 ± 1.0°C using a water bath and provided to calves in steel buckets individually in 2 meals of equal volumes at 0800 and 1600 hours (2.5 L each meal) from day 3 to 56, and 1 meal at 0800 h (2.5 liters) from day 57 until weaning. Milk replacer had 18% whey protein, dried skim milk, and vegetable fat (98% DM, 22% CP, 17% ether extract, 8% ash, 41.8% lactose, < 0.1% crude fiber). Osmolality of the liquid was measured with an osmometer.

Calves were weaned on day 60, and the study was terminated on day 76 of age (there should always be a 2-week post weaning period of any preweaned calf study to measure possible carry over effects as was done in this study). The starter was formulated to achieve a daily gain target of 1.65 lb A hammer mill with a 2-mm screen size was used to grind grains (corn and barley) included in the starter. Calves received a blend of starter plus 8% chopped second-cut alfalfa hay as a TMR throughout the study. Calves had free access to fresh water via individual nipple drinkers mounted on the side wall of the pens, and starter via individual steel buckets mounted on the outside throughout the experimental period. Note the additional labor and cost to grind the grain used in the starter and chop the alfalfa hay when a well-texturized starter eliminates the grinding and chopping and needing to feed hay.

Data in **Table 1** show that:

- Milk solids intake increased as more MR was fed according to treatment protocol.
- ***But*** starter intake decreased as milk solids intake decreased as expected given this inverse relationship.
- Metabolizable energy (ME) and crude protein (CP) intakes increased as more MR was included in the milk fed.
- Initial body weight (BW) was the same among treatments but both treatments with added MR fed increased weaning BW.
- I calculated daily gains before and after weaning at 60 days before the end of the 70-day trial (data lines without SEM). Interestingly, at weaning both added MR treatments had more daily gain than the control; but after weaning the treatment with most MR added prior to weaning had the greatest increase in daily gain. This is a bit obscured when only looking at overall daily gain for the entire 70 days.
- There was a similar pattern for wither height, hip height and width, body length, and heart girth in that both MR-added treatments were a bit greater.

Table 1. Calf intake and performance when fed conventionally with only milk, MR fed short duration in the milk, and MR fed long duration in the milk.

Item	Conventional	Short fed	Long fed	SEM
Milk solid intake, lb/day	66.9	88.1	102.4	0.29
Starter DM intake, lb/day	1.89	1.85	1.67	0.11
Total DM intake, lb	2.50	3.04	3.08	0.11
ME intake, Mcal/day	4.82	5.44	5.55	0.122
CP intake, lb/day	0.636	0.696	0.696	0.020
Initial body weight, lb	87.4	87.6	87.6	1.06

Weaning body weight, lb	168.5	177.3	176.8	3.10
Daily gain at weaning, lb	1.35	1.50	1.46	
Final body weight, lb	203.5	212.1	218.0	4.05
Daily gain after weaning, lb	2.14	2.18	2.58	
Daily gain, lb	1.61	1.71	1.79	0.06
Feed efficiency	0.60	0.59	0.63	0.018

There were a number of other measurements taken such as blood values, ruminal pH and VFA, and body health. While there were some differences in these values, there was a lack of consideration of the osmolality effect.

- Authors did acknowledge that osmolality can be a factor especially when mixing MR into milk and not changing the volume citing McGurk (2003), state that such measurements were made, but there are no data stated nor discussed. Yet, this can be a major issue (Kertz and Loften 2013).
- Daily fecal scores were made prior to the morning feeding (why not during the day?), and on a score of 0, 1, 2, or 3 with 0 being normal. Average fecal scores were 0.225, 0.235, and 0.193, respectively. That is quite surprising that averages were near normal as 50% of illnesses in calves are from diarrhea before weaning which also contributes to 32 % of all deaths in calves (NAMHS 2014), This study would also have been much more complete if water intake was measured to see how calves may have adjusted to MR added to milk treatments and the osmolality effect.

Lastly, these results only apply to calves fed a ground starter with chopped hay. While considerable progress has been made on liquid feeding of calves, quality and feeding of starters seems to have gone backwards. The intake and physical type of starter establishes the platform for eating behavior, functional rumen development, and good weaning transition prior to and after weaning. The physical type and quality of starter often predetermines performance and eating behavior (Ghaffari and Kertz, 2021)

The Bottom Line

` I consider any milk replacer or mix with milk over 15% solids to be in a danger zone due to osmolality. It may not happen if calves drink enough water, if available, to further dilute those solids *in vivo*, but depending on the calf to do so is problematic. Instead, feed more volume at about 13% solids.

References

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