Feedstuffs Reprint

Using refractometers to measure solids in milk fed to dairy calves

THE 2014 National Animal Health Monitoring System (NAHMS) provides key data on a number of calf feeding and management practices (*Feedstuffs*, Sept. 5, 2016).

Among those data is a summary of liquid feeding practices (Table). There are a number of reasons for the wide variety of liquid feeding practices. Smaller herds typically feed more milk replacer because it is simpler to do, while larger herds typically feed more waste milk because they develop a system to collect and feed it to calves, including pasteurizing it.

However, when there's not enough waste milk available to feed all calves, covering the shortage entails feeding some milk replacer, an extender or whole milk from the bulk tank. Waste milk can be variable in solids and nutrient levels (James and Scott, 2006; Jorgensen et al., 2006), and mixing other components with it can create further variability in solids levels.

Calves like consistency in feeding times, amounts and solids levels — just like human babies do, but they do not cry to alert you that something is not to their liking.

At the 2011 Dairy Calf & Heifer Assn. closing session (*Feedstuffs*, May 9, 2011), Sheila McGuirk of the University of Wisconsin Veterinary College provided several examples of how much osmolality and total solids (16-20%) varied on several dairies. This can be more problematic with substitute workers or during the graveyard or weekend shifts.

Milk has a total solids content of about 13%, with an osmolality of 270-300 milliosmoles per kilogram (mOsm/kg).

McGuirk recommended avoiding changing total solids by no more than one percentage unit per day. When total solids exceed 15% with accompanying greater osmolality, abomasal emptying is reduced, which can lead to digestive issues, such as those caused by clostridia (Kertz and Loften, 2013).

This leads to the need for a method that can be used to assess the solids levels in liquids before they are fed to dairy calves.

A group at Washington State University's College of Veterinary Medicine (Floren et al., 2016) conducted a study that measured different solids levels of milk replacers, since 86% of heifer-raising operations fed some milk replacer, and 68% fed only milk replacers when raising calves (NAHMS, 2012).

Bottom Line

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AL KERTZ*

Floren et al. used both a digital refractometer and an optical refractometer, since the latter is often used to measure colostrum quality and serum immunoglobulins.

Five different milk replacers used in the local area were selected. They contained the following % protein/% fat contents: 28/25, 22/20, 22/20, 22/20 and 28/25. Five mixing rates were used in order to capture common mixing rates and then were augmented with a wider range of 6%, 9%, 12%, 15%, 18% and 22% solids to get to a total of 90 samples.

Actual total solids (dry matter) were determined and compared to known mixing amounts, digital and optical refractometer Brix readings were taken and osmolality was measured with an osmometer.

Key relationships were:

- Total solids percent with a digital refractometer = 0.96x + 1.47; R-square = 0.95.
- Total solids percent with an optical refractometer = 0.96x + 1.08; R-square = 0.94.

Osmolality across the different levels of total solids with five different milk replacers had R-square ranging from 0.93 to 0.99. Two milk replacers, when mixed at greater than 16% total solids, had osmolality above the suggested level of 600 mOsm/kg, which is about twice osmolality of milk and intestinal contents.

Thus, there are strong quantitative relationships among these various measurements that all relate to total solids mixing rates. Adding a value between 1.08 and 1.47 from optical or digital refractometer readings, respectively, would provide reasonable estimates of total solids to help monitor milk replacer feeding consistency.

In the same issue of the *Journal of Dairy Science* as the study by Florien et al. appeared, a comprehensive summary was reported by Buczinski and Vandeweerd (2016) in which 11 references comprising 4,251 colostrum samples used a Brix scale with a refractometer to measure immunoglobulin G (IgG) levels.

Good colostrum samples (more than

Types of liquid fed to preweaned calves by herd size (% of operations)

	Herd size, number of head			
	Small (<100)	Medium (100-500)	Large (>500)	All
Non-medicated milk replacer	25.4	20.0	24.3	16.4
Medicated milk replacer	55.1	49.2	33.5	37.6
Unpasteurized milk	67.0	44.2	26.3	55.7
Pasteurized milk	3.3	9.9	28.7	7.4
Milk plus milk replacer	10.9	18.9	20.2	14.4
Other	3.1	0.3	1.4	1.4

Source: NAHMS, 2012.

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50 g of IgG per liter) ranged from 67% to 92% in the studies. Brix values of more than 21% provided a 94% probability that the colostrum would be good; values less than 18% would be poor quality and should be discarded, and values between 18% and 22% should be considered for supplementation.

The Bottom Line

Brix scale digital and optical refractometers provided highly accurate values of total solids using five milk replacers mixed at a range of 6-22% solids (90 total samples). Osmolality readings from these same milk replacer mixes were twice those of milk or intestinal contents when total solids were greater than 15%. These higher total solids levels should be avoided to minimize digestive upset.

A summary study of 11 references in which Brix scale refractometers were used to measure IgG levels in colostrum found that more than 21% of readings were good-quality colostrum with at least 50 g of IgG per liter.

References

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