

# MISCO Digital-Dairy™ Refractometers

## Managing Colostrum Quality, IgG Levels, Waste Milk Solids and Dehydration in Dairy Calves

The MISCO Digital-Dairy Refractometers are handheld refractometers designed for use on professional dairy farms and calf ranches. Rugged enough to withstand the demands of farm use, yet precise enough to give laboratory quality results, the MISCO Digital-Dairy Refractometers can provide reliable estimates of colostrum quality, IgG blood levels, percent solids in waste milk and calf hydration. They are easy to use and require little or no training.

### Colostrum Quality and Failure of Passive Transfer

It is no secret that failure of passive transfer of IgG results in increased disease and death. Low IgG levels in colostrum are responsible for as much as half of the calf losses on US dairy farms.

The Digital-Dairy Refractometers are critical tools which provide an inexpensive and technically simple method for monitoring calf health on the farm. A good surveillance program should follow these steps for monitoring colostrum quality and failure of passive transfer.

#### Colostrum Quality

We have been frustrated by previous attempts at devising a direct reading IgG scale for maternal colostrum quality. At this time, the industry experts feel the best way to monitor colostrum quality is by using a refractometer with a Brix scale.

A cut-off point of 22 Brix was previously advised (Bielmann et al. 2010) as distinguishing between good quality and poor quality colostrum.

Recent work now advocates that 19 Brix is a better cut-off point (Godden et al. 2014).

To make an accurate measurement of colostrum:

1. Set the refractometer to the Brix scale.
2. Place a few drops of colostrum on the measuring surface and allow some time for the temperature of the instrument and sample to equilibrate.
3. Press the <GO> button to take a measurement.
4. It is good practice to take the average of five readings to assure the most accuracy and confirm that readings are not drifting due to unstable temperature.

#### Failure of Passive Transfer

Beyond colostrum “quality” is the issue of assessing that calf health is promoted through the measurement of immunoglobulin (IgG) levels in their blood. The Digital-Dairy Refractometer has many advantages over costly and time consuming RID testing.

Currently, the best field-method for estimating adequate passive transfer on the farm is the measurement of serum total protein by refractometer. Various studies have concluded that there is a direct relationship between IgG concentration and serum total protein in newborn calves (Weaver et al., 2000; Calloway et al., 2002; Godden, 2008; Moore et al., 2009). This is because neonatal calf serum protein is, to a large extent, comprised of immunoglobulins.

Researchers have determined that IgG levels below 10 g/L indicate Failure of Passive Transfer. This correlates with serum total protein cut-off of between 5.2 to 5.5 g/dL. (Naylor et al., 1977; Godden, 2008).

The best method to obtain a serum sample is to take a sample of whole blood and spin it in a centrifuge. MISCO offers a very low cost and robust centrifuge for less than \$200 that is ideal for farm use (see [www.misco.com/dairy](http://www.misco.com/dairy)). However, it is also possible to let the blood sit undisturbed and be allowed to clot in the tube, without centrifuging, and then transfer a serum sample with a pipette to the refractometer for measurement (Wallace et al., 2006). Research has shown that there is no real difference between the type of blood collection tube used and samples may be stored for up to five days prior to testing (Jacob et al. 2014).

#### General Rule of Thumb:

<5.2 g/dl - Failure of Passive Transfer

5.2 to 5.4 g/dl - Some Passive Transfer

≥5.5 g/dl - Successful Passive Transfer

*Note: This method is not valid when using plasma derived colostrum replacers.*

*Rugged enough to withstand the demands of farm use, yet precise enough to give laboratory-quality results.*

#### % Solids in Waste Milk

Non-salable waste milk has been fed to calves for many years and represents a good source of nutrition that is readily

available, cheaper to feed than whole milk, and can be used for little else. However, solids content and bacteria levels are two problems associated with waste milk feeding.

### Solids Content

A quick test of a few drops of waste milk on a MISCO **Digital-Dairy** Refractometer is all that is needed to immediately determine the actual solids content. This is not a Brix reading, but a direct reading of percent milk solids, so no conversion formula is needed.

But waste milk alone usually does not have the solids content needed to maximize nutritional value, and it is often necessary to supplement the waste milk with a suitable commercial calf milk replacer. Once you have determined the existing solids content, it is easy to determine how much calf milk replacer is necessary to increase solids content to the desired level.

Testing another sample, after adding the calf milk replacer, will confirm that you have the correct solids content or identify whether you need to add more calf milk replacer or water to fine-tune the mixture to the desired solids content. Too much and you are wasting calf milk replacer, too little and you are losing nutritional value. *(Note: Read and follow the formulation guidelines for your calf milk replacer to determine the optimal percent solids).*

A **Digital-Dairy** Refractometer makes it easier than ever to measure solids content in waste milk.

### Bacterial Content

The practice of feeding unpasteurized waste milk to calves is no longer recommended because of potentially high levels of bacterial contamination which could ultimately propagate disease throughout the herd. The two primary microorganisms of concern are lactic acid bacteria and coliforms, the latter being the primary culprit for milk spoilage. One quick test for bacterial contamination and milk spoilage can be conducted using a pH

meter, an instrument that measures a solution's acidity and alkalinity.

Milk is slightly acidic to start with and has a typical pH between 6.5 to 6.7 when fresh. As milk begins to spoil, due to bacterial contamination, it becomes more acidic and its pH levels can drop sharply. pH values lower than 6.5 are an indicator of bacterial contamination and may fall as low as 4.4 for milk that is completely spoiled, while pH values higher than 6.7 usually indicate the presence of mastitis. It is recommended that milk be discarded if its pH is less than 6.3 or more than 7.0.

pH meters are available directly from MISCO, or other sources, for testing for milk spoilage.

### Calf Scours & Dehydration

Common sense tells you that a calf will become dehydrated when it loses more fluid than it consumes. Whether as a result of scours or other reasons, severe hydration in calves is not hard to detect. However, mild dehydration can occur without symptoms and continue until it is nearly too late. Calves can lose up to six percent of their body weight in fluid before there is any visual indication of dehydration. If dehydration is caught early enough, fluid therapy can reverse it, but the key is catching it early.

A **Digital-Dairy** Refractometer, equipped with a large-animal urine specific gravity scale, can quickly measure calf hydration. According to a study on "Urine concentration as an indicator of dehydration in newborn calves with diarrhea," (Doll et al), a urine density of 1.014 g/cm<sup>3</sup> (specific gravity 1.016 D 20/20), was able to detect dehydration, consistent with a fluid loss equal to three percent of body weight, with an accuracy of 90%.

It only takes two or three drops of urine, and the press of a button, to get an instant and accurate reading of urine specific gravity on a MISCO **Digital-Dairy** Refractometer.

## How is the MISCO Digital-Dairy Refractometer Different from Other Refractometers?

There are a number of ways in which the MISCO **Digital-Dairy** Refractometers differs from other refractometers.

- They have a digital display which removes the subjectivity associated with reading the scales on traditional analog refractometers.
- They have scales specific to dairy needs, such as a direct reading milk solids scale, a serum total protein scale, and a Brix scale.
- They automatically temperature correct readings.
- They are the highest precision handheld refractometers available.

If you have used a traditional analog (look through) refractometer to measure milk, you may have noticed that the shadowline projected on the measuring scale is fuzzy. Sometimes it is so fuzzy that you can't even take a reading. This is because milk is an emulsion and emulsions can be difficult to read on most refractometers.

An emulsion is comprised of a continuous phase and a dispersed phase, each with its own refractive index. The fat in milk is secreted by the cow in globules of non-uniform size, ranging from ~ 0.20 to 2.0  $\mu\text{m}$ . Globules of less than 0.65  $\mu\text{m}$  are additive to the overall refractive index. However, once globules increase in size to ~0.65  $\mu\text{m}$  and beyond, they will begin to express their own unique refractive indices. This creates a solution with a non-uniform refractive index and the shadowline becomes fuzzy.

Thanks to the OPTICAL-ENGINE, at the heart of every MISCO **Digital-Dairy** Refractometer, MISCO refractometers are better equipped to measure hard-to-read emulsions. The OPTICAL-ENGINE features a high-precision sapphire measuring surface, the next hardest substance to diamond, which also

improves the speed and accuracy of temperature compensation. Other digital refractometers only use an ordinary glass prism.

A 1,024 element high-definition detector array provides more than eight times the resolution of the 128 element low-definition arrays found in other digital refractometers. The MISCO array has more than 3,256 ppi resolution compared with 400 ppi resolution in

other digital refractometers. Compare this to a shadowline projected on the reticle of a traditional analog refractometer; the human eye can only discern ~300 ppi resolution. It is the additional resolution which allows MISCO refractometers to read emulsions so much better.

The MISCO **Digital-Dairy** Refractometers have multiple scales, a stainless steel measuring well, an

evaporation cover, and large 24-character back lit display. To top it off, the MISCO **Digital-Dairy** Refractometer is proudly made right here in the USA.

For more information on the MISCO **Digital-Dairy** refractometers, please visit [www.misco.com/dairy](http://www.misco.com/dairy) on the MISCO website.

Following is a listing of the standard **Digital-Dairy** Refractometers available from MISCO, custom configurations are available upon request:

**Digital-Dairy Model #DD-1**

Configuration Code #PA202X-003-466

Scale #	Fluid	Unit of Measure	Range	Resolution	Precision (+/-)
003	Colostrum	Brix	0 to 85	0.1	0.1
466	Total Solids in Waste Milk	% Total Solids	5 to 15	0.1	0.5

**Digital-Dairy Model #DD-2**

Configuration Code #PA202X-003-105

Scale #	Fluid	Unit of Measure	Range	Resolution	Precision (+/-)
003	Colostrum	Brix	0 to 85	0.1	0.1
105	Blood Serum Total Protein	g/dL	1 to 14 g/dl	0.1	0.1

**Digital-Dairy Model #DD-3**

Configuration Code #PA203X-003-098-105-466

Scale #	Fluid	Unit of Measure	Range	Resolution	Precision (+/-)
003	Colostrum	Brix	0 to 85	0.1	0.1
098	Urine - Large Animal	Specific Gravity D20/20	1.000 - 1.065	0.0001	0.0005
105	Blood Serum Total Protein	g/dL	1 to 14 g/dl	0.1	0.1
466	Total Solids in Waste Milk	% Total Solids	5 to 15	0.1	0.5

Note: Other scale combinations can be made using the [Build-Your-Own](#) section on the MISCO website.

*A world leader in the refractometer field, MISCO is headquartered in Northeast, OH, home to the company for 60+ years. MISCO designs, manufactures and sells a variety of refractometers, including: digital bench-top laboratory refractometers, inline process control refractometers, digital handheld refractometers, and traditional handheld instruments. For more information, please call toll free (800) 358-1100, or access MISCO's web site at [www.misco.com](http://www.misco.com)*

**MISCO is a proud member of the Dairy Calf and Heifer Association & Supporter of the Ohio Farm Bureau.**