



## APPLICATION NOTE - DETERMINING LACTOSE CONTENT IN MILK BY POLARIMETRY

**Application Need:** One of the easiest methods of determining the lactose concentration in milk is through polarimetry. Normal milk contains 45-50 g lactose per liter. For the lactose measurement to be successful, all optically-active compounds except for the lactose (for instance, proteins) must be removed, and the solution must be transparent enough for polarized light to pass through readily. Setting the polarimeter to the correct angle for the optical rotation value is tricky and must be done carefully to avoid erroneous values.

**Solution:** Use Reichert's Polar3 polarimeter to accurately determine the lactose content of milk.

### Overview

The **specific rotation** of a substance is defined as the optical rotation of a solution containing 1 g/ml in a 100 mm polarimeter tube. It is affected by temperature (20°C reference temperature) and wavelength (usually the sodium D line, 589 nm, is used), and can be measured using the following formula:

$$[\alpha]_D^{20} = \frac{\alpha}{c \cdot d}$$

where  $\alpha$  is the measured optical rotation;  $d$  the light patch in dm, and  $c$  the concentration as g/ml. The specific rotation,  $[\alpha]$ , of lactose in solution at equilibrium is +52.3°.

### Procedure for Measuring Lactose

Use the following procedure to measure the lactose present in the sample.

#### 1. Remove the fat and protein from the sample

The first step in preparing the milk sample requires that you remove all fat and protein. To do this, use a volumetric pipette to transfer 50.0ml of milk to a 125 ml Erlenmeyer flask. Add 7.5 ml of concentrated sulfuric acid to the milk. To this mixture, add 7.5 ml of a mercury iodine/potassium iodine solution. (Note the precipitation of milk proteins.) Filter the solution to remove the precipitate. Rinse the Erlenmeyer and wash the protein solids with water to ensure that the dissolved lactose is transferred completely. Transfer the filtrate to a 100 ml volumetric flask and carefully dilute the solution to 100 ml total volume. Discard the solidified proteins.

#### 2. Measure the optical rotation

Fill a clean, 100 mm-long polarimeter tube with the diluted milk solution at 20°C. Place the filled sample tube in the polarimeter and record the measured value (angular degree).

#### 3. Calculate the concentration of lactose

Using the following formula, solve for  $c$  to calculate the concentration of the diluted milk:

$$[\alpha] = \frac{a}{c \cdot l}$$

where  $c$  is the concentration in grams per 100 ml,  $l$  is the path length in dm,  $[\alpha]$  is the specific rotation, and  $a$  is your measured value.

Use this concentration value to calculate the number of grams of lactose present in the diluted milk (which is the same as grams in the undiluted milk). In calculating the concentration of lactose, a correction should be used for the concentration of fat and protein in the precipitate.

### Product Recommendations:

**Polar3** Polarimeter – Reichert Cat #14003000

