DEXTROSE EQUIVALENT (Lane and Eynon)

PRINCIPLE

Methods most commonly used for estimation of aldose-type sugars are based on their reducing action toward certain metallic salts. In the following modification of the Lane and Eynon procedure, dextrose, maltose and related sugars contained in the sample reduce copper sulfate in an alkaline tartrate system (Fehling's Solution). Dextrose equivalent is defined as "reducing sugars expressed as dextrose and calculated as a percentage of the dry substance."

SCOPE

The method is applicable to crude and refined corn sugars, corn syrups and all starch hydrolyzates prepared by acid or enzyme conversion and combinations thereof. This method can be used for the analysis of starch molasses (Note 1). It is not applicable to syrups containing fructose or invert sugar (Note 2).

SPECIAL APPARATUS

Titrating Assembly: Mount a ring support on a ringstand 1-2 ins. above a gas burner and a second ring 6-7 ins. above the first. Place a 6 in. open wire gauze on the lower ring to support a 200 mL Erlenmeyer flask and a 4 in. watch glass with center hole on the upper ring to deflect heat. Attach a 25 mL buret to the ringstand so that the tip just passes through the watch glass centered above the flask (funnel top buret with diagonal TEFLON Plug, KIMAX No. 17055F recommended). Place an indirectly lighted white surface behind the assembly for observing the end point.

REAGENTS

1. Fehling's Solution:

   A. Dissolve 34.64 g of reagent grade crystalline copper sulfate pentahydrate ($CuSO_4 \bullet 5H_2O$) in purified water and dilute to 500 mL volume.

DEXTROSE EQUIVALENT — continued

B. Dissolve 173 g of reagent grade potassium sodium tartrate tetrahydrate ($KnaC_4H_4O_6 \bullet 4H_2O$) and 50 g of reagent grade sodium hydroxide (NaOH) in purified water and dilute to 500 mL volume.

Measure a quantity of Solution A, add an equal quantity of Solution B, and mix (Note 3). Standardize as follows, immediately prior to use:

Dry a quantity of National Institute of Standards and Technology (NIST) dextrose in a vacuum oven at 70 °C for 4 hrs. Dissolve 3.000 g in purified water, dilute to 500 mL volume and mix thoroughly. Pipet 25.0 mL of mixed Fehling's Solution into a 200 mL Erlenmeyer flask that contains a few glass beads, and titrate with the standard dextrose solution as directed under procedure. Adjust concentration of Fehling's Solution A by dilution or addition of copper sulfate so that the titration requires 20.0 mL of the 0.6% standard dextrose solution.

2. Methylene Blue Indicator: 1% aqueous solution

PROCEDURE

Weigh accurately an amount of sample such that after dilution the solution contains about 0.6% reducing sugars (Note 4). Transfer the sample quantitatively to a 500 mL volumetric flask with the aid of hot water, cool to room temperature, dilute to volume and mix thoroughly.

Pipet 25.0 mL of standardized mixed Fehling's Solution into a 200 mL Erlenmeyer flask and add a few glass beads. Add the sample solution by means of the buret to within 0.5 mL of the anticipated end point (determined by preliminary titration). Immediately place the flask on the wire gauze of the titration assembly, and adjust the burner so that the boiling point will be reached in about 2 mins. Bring to boil and boil gently for 2 mins. As boiling continues, add 2 drops of methylene blue indicator and complete the titration within 1 min. by adding sample solution dropwise or in small increments until the blue color disappears (Note 5).
Determine the dry substance concentration of the sample by an approved procedure.

DEXTROSE EQUIVALENT — continued

CALCULATION

$$\%\ \text{Reducing Sugars (as is, calc. as dextrose)} = \frac{(500\ \text{mL})(0.1200)(100)}{(\text{Sample Titer, mL})(\text{Sample Wt., g})}$$

$$\text{Dextrose Equivalent} = \frac{(\%\ \text{Reducing Sugars})(100)}{\%\ \text{Dry Substance}}$$

NOTES AND PRECAUTIONS

1. The Association of American Feed Control Officials defines starch molasses as "the by-product of the manufacture of dextrose from starch derived from corn or grain sorghums in which the starch is hydrolyzed by use of enzymes and/or acid."
2. Pure D-fructose responds to Fehling solution differently from D-glucose and its oligo- and polysaccharides. The method may be standardized against a mixture of saccharides of similar composition to the test sample and the results may be expressed as mg reducing sugars in the sample.

3. Fehling's Solution in mixed form is relatively unstable but may be retained up to 1 week if standardization is confirmed before using.

4. In the analysis of refined sugars, use 3 g of sample dry substance. For other sample types, including starch molasses, calculate approximate sample weight using the following formula:

$$\text{Sample Weight} = \frac{(3\ \text{g})(100)(100)}{(\text{Anticipated D.E.})(\%\ \text{Dry Substance})}$$

   Concentration should be such that sample titer is near 20 mL, but should not exceed limits of 15 and 25 mL. Inter- and intralaboratory precision is improved by adjusting all sample concentrations to provide titers between 19 and 21 mL.

5. When approaching the end point, allow about 5 secs. reaction time between additions of sample solution.

DEXTROSE EQUIVALENT — continued

METHOD HISTORY

Combined the Dextrose Equivalent (Lane and Eynon) methods for Corn Syrup (E-26) and Corn Sugar (F-22) on 4-15-2010.

Corn Syrup, Dextrose Equivalent (Lane and Eynon) (E-26), Date of Acceptance 5-27-1968, Revised 7-9-1993.

Corn Sugar, Dextrose Equivalent (Lane and Eynon) (F-22), Date of Acceptance 3-20-1972, Revised 2-27-1996.