Application Bulletin

Metrohm

Of interest for:
Soft drinks industry
Foodstuffs laboratories

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Polarographic determination of fructose

Summary

Fructose (fruit sugar) is the only naturally occurring ketose. It is found in the free state, mixed with glucose, in honey, sweet fruit and tomatoes, or combined as a component of cane sugar and various starch-like carbohydrates. Since fructose has a sweeter taste than glucose, it is of great importance as a sweetening agent.

The polarographic reduction of sugar was first described by Heyrovsky and Smoler in 1932. The procedure described below enables the fructose content of fruit, fruit juices and honey to be determined simply by a quantitative polarographic method.

Apparatus

- 2.506.00XX Polarecord or 2.626.00XX Polarecord with 2.663.002X VA Stand
  WE = DME, AE = Pt, RE = Ag/AgCl, LiCl sat. in ethanol

Reagents

- **Ethanol puriss p.a.** $w = 0.8$ (80%)
- **Gelatine solution** $w = 0.01$ (1%)
- **Background solution** c(LiCl/LiOH) = 0.1 mol/L each
- **Standard solution** Dissolve 10 g fructose in distilled water and make up to 100 mL. 0.1 mL ≙ 10 mg

Methods

- **Determination in fruit juice**

  To a sample of 0.2 ... 0.5 mL fruit juice, add 20 mL background solution plus 0.2 mL gelatine solution, and deaerate with nitrogen. Then record either a DC-rapid or DC-normal polarogram.

- **Determination in fruit**

  According to the fructose content expected, place 10 ... 20 g of crushed or shredded fruit in an evaporating basin and add 50 mL of ethanol. Evaporate off the alcohol over a water-bath, stirring occasionally with a glass rod. Extract the residue several times with distilled water, and filter into a 100 mL calibrated flask. Make up to the mark with distilled water and mix thoroughly. Pipette off 1 mL of this solution, and analyse as described under "fruit juice".

  Settings on 506 Polarecord:

Method	DC
U_{start}	– 1.6 V
ΔU	– 2 V
Sensitivity	$1.5 \cdot 10^{-7}$ A/mm
Drop/s	1
mm/drop	rapid 1, normal 0.5
Damping	normal only, "red 4"

Evaluation

- The fructose content is calculated by means of the standard addition method. The sample is enriched by adding an increment of 20 mg (200 µL) of the standard fructose solution, and the polarogram plotted again. The fructose content can be easily calculated from the average difference between the normal sample and the enriched sample at the potential values –1.96 / –2.00 V and –2.04 V.

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Remarks

- With acid samples, it is recommended to adjust the pH beforehand with LiOH.
- K^+ and Na^+ ions may interfere with the determination, particularly when small quantities of fructose are being analysed. In such cases it is recommended that the disturbing ions be removed with a cation exchanger.
- Valid results cannot be obtained by the AC or DP methods.
- The $CaCl_2$ background electrolyte recommended in the original edition of this Bulletin has shown itself to be unsuitable, as it is generally too impure, and contains too many Na^+ and K^+ ions.
- The determination may not be done on the 646 VA Processor.

Literature

- Brezina / Zuman
  Die polarographische Analyse in der Medizin, Biochemie und Pharmazie
  Akad. Verlagsgemeinschaft Geest & Portig KG, Leipzig 1956
- Williams / McComb / Potter
  Determination of Levulose in Fruit
  Anal. Chem. 22, (1950) 1031
- Swann / McNabb / Hazel
  Polarography of the fructose-borate system
  Anal. Chim. Acta 28, (1963) 441-449

Example

Curve A Background solution + 0.2 mL apple juice

Curve B A + 20 mg standard

U	A	B	Δ
–1.96	13 mm	35 mm	22 mm
–2.00	22 mm	59 mm	37 mm
–2.04	33 mm	90 mm	57 mm
Sum	68 mm	184 mm	116 mm
/3	22.7 mm	61.3 mm	38.7 mm

Calculation: 38.7 mm / 20 mg = 22.7 mm / X mg

X = 20 × 22.7 / 38.7

= 11.73 mg / 0.2 mL

= **58.66 g/L fructose**