Application Note
Food & Feed Industry

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Starch Determination

Raw Starch Determination using Hydrochloric acid according to Ewers

The determination of starch content is a key analytical step in quality control across various industries. The polarimetric starch determination according to Ewers is a well-established and precise method based on measuring the optical rotation of starch hydrolysates. Since starch is enzymatically or chemically converted into glucose, its concentration can be accurately quantified via the optical activity of the resulting solution. This technique provides reliable results for a wide range of samples — from food and beverages to pharmaceuticals and paper products — ensuring consistent product quality and compliance with regulatory standards.

To accurately quantify starch content according to the Ewers method, the optical rotation of two fractions must be determined — the total optical rotation and that of ethanol-soluble substances. Both measurements are essential to calculate the starch concentration with precision.

Determination of Total Optical Rotation

For the total optical rotation, approximately 2.5 g of the prepared sample is weighed and hydrolyzed with hydrochloric acid in a boiling water bath for 15 minutes. Vigorous shaking during the initial heating phase prevents agglomeration and ensures complete hydrolysis. After adding 30 mL of cold water and cooling to 20 °C, the solution is clarified by sequential addition of Carrez solutions I and II, which precipitate proteins and other interfering substances. The mixture is then diluted to 100 ml with water, filtered, and measured in a 200 mm polarimeter tube. If the filtrate remains turbid, the clarification step is repeated with an increased volume of Carrez reagents to obtain a clear solution suitable for optical measurement.

Determination of Optical Rotation of Ethanol-Soluble Substances

In parallel, the optical rotation of ethanol-soluble substances is determined to account for non-starch components that may influence the total rotation value. About 5 g of the sample is extracted with 80 mL ethanol and left to stand for one hour, with intermittent shaking to ensure thorough dispersion. After dilution with ethanol to 100 mL and a filtration, 50 ml of the filtrate is hydrolyzed with hydrochloric acid and heat under reflux for 15 minutes, then cooled to 20 °C. The solution is clarified using Carrez solutions I and II, diluted to 100 ml with water, filtered, and its optical rotation measured under the same conditions as the total hydrolysate. This measurement allows correction for soluble sugars and other interfering substances, providing the basis for an accurate determination of the true starch content.

Calculation

Calculate the percentage of starch in the sample using the following formula, according to the method of measurement used:

1. Measurement by circle polarimeter

$$\text{Starch (\%)} = \frac{2{,}000\ (\alpha - \alpha^1)}{\alpha_D^{20\,°C}}$$

α = total optical rotation in degrees

α^1 = optical rotation in degrees of substances soluble in 40 % ethanol

$\alpha_D^{20\,°C}$ = specific rotation of pure starch

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For the determination of starch content, both a circle polarimeter (UniPol V or Polartronic V) and a saccharimeter (Saccharomat V) can be used to measure the optical rotation of the sample solution. While a conventional circular polarimeter directly provides the optical rotation in degrees, the Saccharomat expresses the result in °Z (International Sugar Scale). Therefore, when using a Saccharomat, a specific calculation must be applied to convert the measured °Z value into the corresponding optical rotation value required for starch determination according to the Ewers method.

$$\text{Starch (\%)} = \frac{2{,}000}{\alpha_D^{20\,°C}} * \frac{(2N * 0.665)(Z - Z^1)}{100} = \frac{26.6N(Z - Z^1)}{\alpha_D^{20\,°C}}$$

Z = total optical rotation in degrees Z

Z^1 = optical rotation in degrees Z of substances soluble in 40 % ethanol

N = weight of sucrose in g per 100 mL water which gives a rotation of 100 °Z

$\alpha_D^{20\,°C}$ = specific rotation of pure starch

The specific optical rotation of starch varies depending on the botanical source of the sample, such as maize, potato, or wheat starch. Because each starch type exhibits a characteristic optical rotation, it is essential to know the exact source of the starch in order to apply the correct reference value and obtain accurate and reliable measurement results.

Barley starch = +181.5 °
Maize starch = +184.6 °
Oat starch = +181.3 °
Potato starch = +185.7 °
Rice starch = +185.9 °
Wheat starch = +182.7 °
Tapioca starch = +183.6 °
Other starches = +184.0 ° (starch mixtures in compound feeding stuffs)

Recommended Product Packages	Product	ID-N°
UniPol V	UniPol V 200 mm Flow Through Tube with Funnel Quartz Control Plate + cable	18510 18700 18760 + 16534
Polartronic V	Polartronic V 200 mm Flow Through Tube with Funnel Quartz Control Plate	16245 03830 18760 + 16251

Benefits

- Accurate, fast and precise measurement
- Product quality securing

Typical Industries

- Food Industry
- Sugar Industry
- Paper Industry
- Pharmaceutical Industry

Scan QR code or click here to get a quote!

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