Waters
Lab Highlights
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ANALYZING GLUCOSE SYRUPS WITH THE DEXTRO-PAK™ RADIAL-PAK™ CARTRIDGE

Many plants store energy in tubers and grains in the form of starch, which is a polymer of glucose (dextrose).

During this century, a large industry has grown to process these starches, by acidic or enzymic hydrolysis, to produce a sweet, viscous syrup which is usually called corn syrup or glucose syrup.

Conversion of the starch to glucose (monomeric dextrose) is not complete, and the commercial syrups typically contain some higher molecular weight fractions (usually called dextrins) and glucose oligomers. These dextrins and oligomers give the glucose syrup its high viscosity.

Manufacturers of these syrups need to monitor and control the hydrolysis. One method of doing this was by wet chemistry using a reagent, such as Fehling's solution, to determine the number of glucose end groups available. This led to the use of the term Dextrose Equivalent (D.E.). 100% pure glucose monomer would have a Dextrose Equivalent of 100. A very low conversion starch may have a D.E. of 5. A commonly used syrup of commerce has a D.E. of 42. Thus D.E. gives a measure of the sweetness and viscosity of these syrups.

Another term which is used is DP which means Degrees of Polymerization of the glucose oligomers. Monomeric glucose would have a DP of 1. Its dimer, maltose, would have a DP of 2. An oligomer having 6 glucose units would have a DP of 6, and so on.

In recent years, LC has been used to analyze these syrups. The most commonly used column is packed with a sulfonated polystyrene resin, usually in the calcium form, such as Waters™ Sugar-PAK™ I column, using water as the mobile phase. This produces a separation, by what is essentially a GPC mode, in which the high molecular weight dextrins elute first and the monomer last, as shown in Figure 1. Note that all of the sample elutes from these columns.

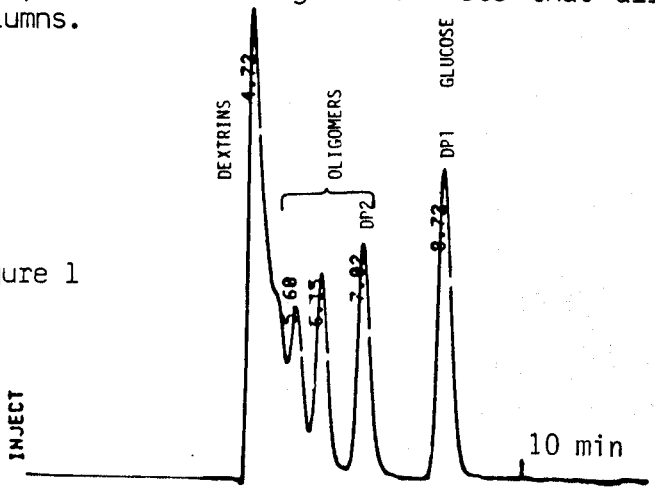

Figure 1

Sample: 42DE glucose syrup
Column: Sugar-PAK™ 1
Column Temp.: 90°C
Mobile Phase: Water
Flow Rate: 0.6 ml/min
Detector: Model R401 RI

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A different type of separation is given by the Waters™ Carbohydrate Analysis Column. With this column, the glucose elutes first, followed by the larger oligomers, as shown in Figure 2. Very high molecular weight fractions do not elute. The Carbohydrate Analysis Column separation has usually not been used routinely, partly due to the relatively delicate nature of its NH_2 packing and partly because the 65% acetonitrile used as mobile phase is not as cheap or as safe as the water used for the polystyrene column.

Waters has developed the Dextro-PAK Radial-PAK™ cartridge which combines some of the best features of both these systems. The separation obtained is almost identical to the Carbohydrate Analysis Column, giving useful information on the oligomer content of the hydrolyzates. Like the carbohydrate column, the high MW fractions remain on the column, but their presence does not interfere significantly with the separations. The packing is a reverse-phase type which has been optimized for this separation. The column is very stable, it operates at ambient temperature and uses water as the mobile phase. A typical separation of a 42DE glucose syrup using Dextro-PAK Radial-PAK™ cartridge is shown in Figure 3. Faster separations may be obtained on Dextro-PAK with a small loss of resolution by increasing the flow rate.

FIGURE 2

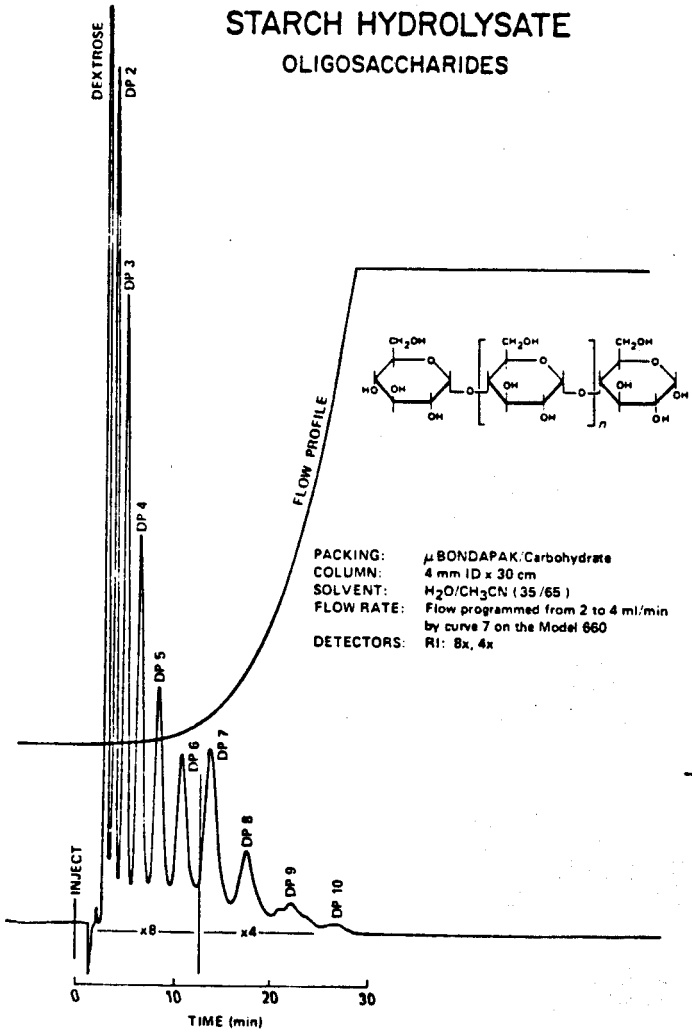

FIGURE 3