Analysis of Cornflour by GPC with Viscometry

Application Note

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Introduction

Cornflour or cornstarch is the starch of the maize grain ground from the endosperm of the corn kernel. Starches contain two structurally different polysaccharides, amylose and amylopectin. In cornflour, the ratio of these materials is typically around 25:75. When mixed with water, cornflour behaves as a non-newtonian fluid showing typical shear thickening behavior, giving way to gentle pressure but resisting sudden impact. Many uses of cornflour in the food industry rely on the thickening and anti-coagulant properties of the material, whereas in the plastics industry the fact that the material can be extruded, milled and injection moulded, but is biodegradable, has generated much interest, including the development of a biodegradable Blu-ray Disc made from the material.

Two samples of cornflour from different sources had displayed differing properties when used as thickening agents in a food application. It was thought that variations in levels of the linear amylose and the highly branched amylopectin polysaccharides were responsible for this behavior. To investigate the molecular structure of the materials, they were analyzed on an integrated GPC system. Molecular weight distributions were determined using the Universal Calibration method, and the structure of the samples was compared using the Mark-Houwink plot of log (intrinsic viscosity) as a function of log (molecular weight). Increased amount of branched material would result in a contraction in the molecular size of the materials with a downward deviation in the Mark-Houwink plot.

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Instrumentation

The cornflours were analyzed by an Agilent PL-GPC 50 Plus fitted with an Agilent PL-BV 400RT viscometer and Agilent PLgel 10 µm MIXED-B columns, which provide high resolution of polymers with high molecular weights even in demanding eluents.

Columns: 3 x PLgel 10 µm MIXED-B 300 x 7.5 mm (p/n PL1110-6100)

Materials and Reagents

Samples: 2 x Cornflour
Eluent: Dimethyl sulfoxide + 0.1% lithium bromide

Conditions

Flow Rate: 1 mL/min
Temperature: 50 °C

Results and Discussion

Figure 1 shows a chromatogram of a sample of cornflour. Clear differences in the molecular weight distributions of the samples are apparent in Figure 2, and the effect of changes to the content of amylase and amylopectin could be observed in the shifts of the Mark-Houwink plots (Figure 3).

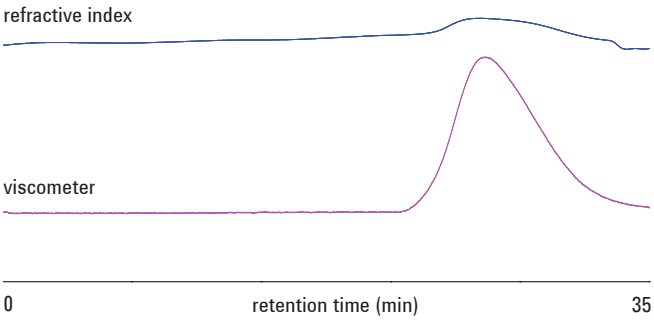

Figure 1. Example chromatograms of one of the cornflour samples

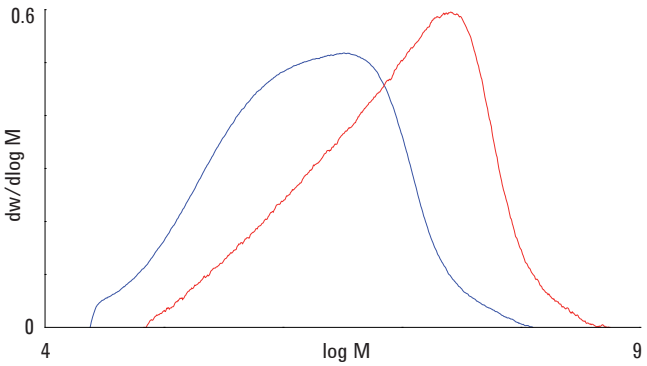

Figure 2. Overlaid molecular weight distributions for two cornflour samples

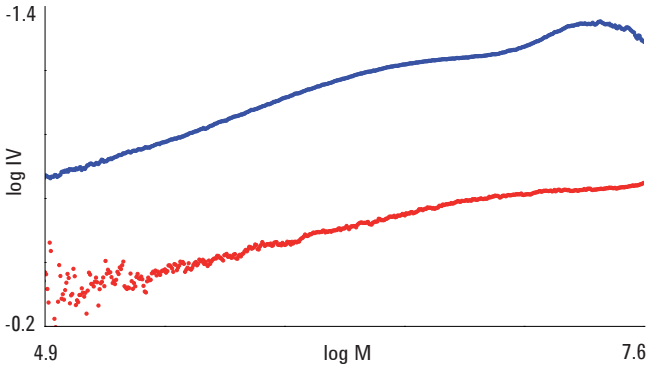

Figure 3. Overlaid Mark-Houwink plots for two cornflour samples

Conclusion

The PL-GPC 50 Plus is a high resolution, cost effective integrated GPC system designed for operation from ambient to 50 °C. The standard system comprises precision solvent delivery, sample injection, high performance differential refractive index detection and a column oven, with fully integrated software control. When coupled with PLgel MIXED-B columns, a PL-BV 400RT viscometry detector, the PL-GPC 50 Plus uses GPC visometry for the accurate determination of polymer molecular weights.

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