Rapid Visco Analyser 4800 (RVA 4800)

The Rapid Visco® Analyser (RVA) is a cooking and stirring viscometer with ramped temperature and variable shear profiles, optimized for testing viscous properties of starch and similar temperature-dependent hydrocolloids. The RVA 4800 can perform regular tests below 100 °C, as well as high-temperature tests up to 140 °C in a specially designed pressure vessel. The instrument includes international standard methods as well as full flexibility for customer tailor-made profiles. Combining speed, precision, flexibility and automation, the RVA is a unique tool for product development, process control and quality assurance.

Scope

• Monitor consistency of ingredients between batches.
• Determine ingredient suitability and behavior in processing.
• Product development.
Description

Pulse ingredients impart desirable functional properties to a variety of food, beverage, and animal feed products. Because they contain heat-resistant starches and proteins, pulse ingredient functionality can be difficult to characterize at temperatures below 100 °C. For example, some pulse flours require cooking at 120 °C to produce the highest (peak) viscosity, as opposed to cereal flours that already exhibit their maximal viscosity at 95 °C.

Using the extended temperature capabilities of the RVA 4800, pasting behaviors of samples can be continuously measured up to 140 °C. This allows for assessment of pulse ingredient and product behavior under high temperatures employed in processes such as canning, jet-cooking, and extrusion. The viscosity and pasting behaviors of starch-rich ingredients are affected by several factors, such as amylose content, gelatinization properties of the starch, and interactions between starch and other components (e.g. proteins, dietary fibers, lipids) (Figure 1).

This method is applicable to starch-rich pulse ingredients or products in a ground powder or liquid form, including isolated starches¹, flours², whole meals, and their formulations.

Method

High-temperature pasting profile with selectable maximum temperature (e.g. 95 °C, 120 °C, 140 °C, etc.).

Test requirements

RVA mode: High temperature coupling, lever forward
Cans & Paddles: High temperature, tray of 42 (P/N PERNS106944)

Sample Preparation

- For pulse flours, use 3.50 g sample at 14% moisture (3.01 g if using dry solids basis) in 28.5 g of total suspension. Use distilled or deionized water as the solvent.

- For isolated pulse starches, use 2.24 g dry solids in 28.0 g of total suspension. Use distilled or deionized water as the solvent.

Figure 1: RVA pasting curves of pulse flours²(A) and starches¹ (B) at different holding temperatures. Note the pasting of wrinkled pea starch (higher amylose) is more pronounced at temperatures above 120 °C. Figures are reprinted with permission from Elsevier.
Measure

PT: Pasting temperature (˚C)
PV: Peak viscosity (cP)
BD: Breakdown (cP)
TV: Trough/minimum viscosity (cP)
SB: Setback (cP)
FV: Final viscosity (cP)

The PV measured at various maximum hold temperatures provides an indication of the sample's ability to paste under those conditions. PV is influenced by factors such as sample purity and the presence of matrix proteins and dietary fibers that may restrict viscosity development of the pulse starch granules. The FV at the end of the test is an indicator of the sample’s ability to set upon cooling. FV is influenced by factors such as the degree of starch pasting and amylose content in the sample (FV is typically higher with more amylose leaching).

Description of Method

In this profile, different hold temperatures may be selected. This selection will depend on what questions are to be addressed in the analysis, and/or the food processing conditions that are relevant for the pulse ingredient being tested. In general, the program used in this test (Table 1) consists of the following steps:

1) equilibration at 50 ˚C for 1 min
2) ramping to the desired hold temperature at a heating rate of 6 ˚C/min
3) maintaining at the hold temperature for 5 min
4) cooling to the initial 50 °C at 6 °C/min, and
5) maintaining at 50 °C for 2 min

The paddle is set to rotate at 960 rpm for the initial 10 s to fully suspend the flour sample, followed by a constant stir rate of 160 rpm for the remainder of the RVA test.

While a rapid heating/cooling rate of up to 14 °C/min can be achieved with the RVA when it is necessary to save time, use of a more gradual heating/cooling rate minimizes temperature lag and improves resolution. This helps account for protein/lipid interactions with starch that may delay or interfere with the onset of gelatinization and the process of retrogradation. The slower temperature ramp is particularly important for pulse flours, where it allows for greater detail to be observed in the pasting profile. This increased detail allows for a better understanding of functional effects caused by component interactions.

Table 1: Profiles for 95 °C, 120 °C and 140 °C tests.

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
<th><em>95 °C</em></th>
<th><em>120 °C</em></th>
<th><em>140 °C</em></th>
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<td>00:01:00</td>
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<td>00:38:00</td>
</tr>
</tbody>
</table>

Idle Temperature: 50 ± 1°C
Time Between Readings: 4 s

a,b Based on the methodology from Liu et al., 2019.

References