newport scientific world 3

Hydration and Viscosity of Hydrocolloids

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To ascertain the usefulness of a thickener it is necessary to hydrate the gum powder and measure viscosity of the suspension/solution at temperatures of interest. The RVA gives the potential to measure both the viscosity profile and ascertain how rapidly and successfully the materials hydrate. Many gums require high shear mixing and lengthy hold times to ensure full hydration and achievement of their full viscosity. Measurement of gum suspensions, as they hydrate, is often difficult in fundamental rheometers due to the small gap sizes and settlement of the particulates. With the RVA the facility to increase the stir speed allows the suspensions to be thoroughly mixed and then at lower speeds reproducible values for the viscosity can be recorded.

Figure 1 illustrates that a sample of gum stirred at 960 rpm for 20 sec. and then stirred at 160 for the rest of the period shows characteristic viscosity profiles. The guar hydrates rapidly, even in the cold water, and achieves viscosities at the start of the cycle as high as at the end of the program. The locust beam gum shows no cold-water viscosity and requires temperatures in excess of 60°C before maximum viscosity can be achieved. Although much can be learnt from these curves, the poor dispersion of the samples hinders interpretation. To assist in the dispersion the gums were initially mixed with 2 ml of ethanol in the bottom of the canister before addition of the cold water, but still the aggregation and poor hydration of the gums gives rise to uneven viscosity profiles.

To overcome the problems of clumping and settlement of particulates different stirring speeds can be used. Figure 2 shows the profile used to successfully benchmark many different types of hydrocolloids using the RVA. The arrows indicate the point where the samples' viscosities are recorded. At these points the stirring speeds are sufficiently low so that there is no turbulence, but the higher speeds are then used to ensure all the material remains in suspension. Figure 3 shows the viscosity profiles for the same guar and LBG as shown in Figure 1.

As well as providing useful information on the gums the RVA can provide a precise mechanism for the preparation of samples that can then go on to be used for other types of rheological assessment, including the preparation of samples that will gel.

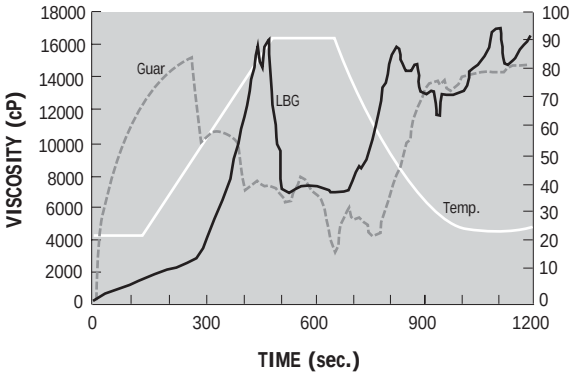

Figure 1
Guar and locust beam gum (LBG) in water (1.5 g gum plus 16.5 g water).

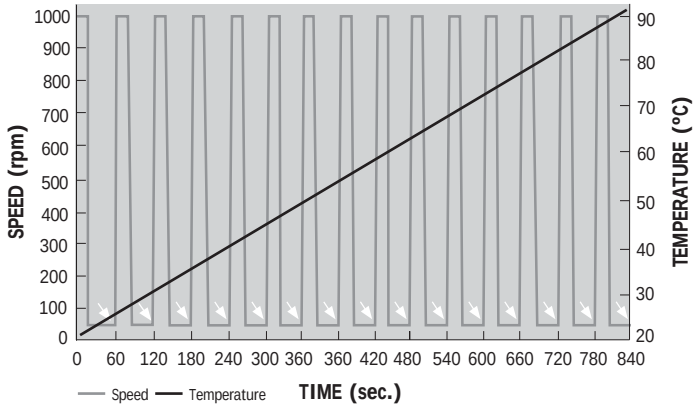

Figure 2
Temperature and speed profiles used to measure gums.

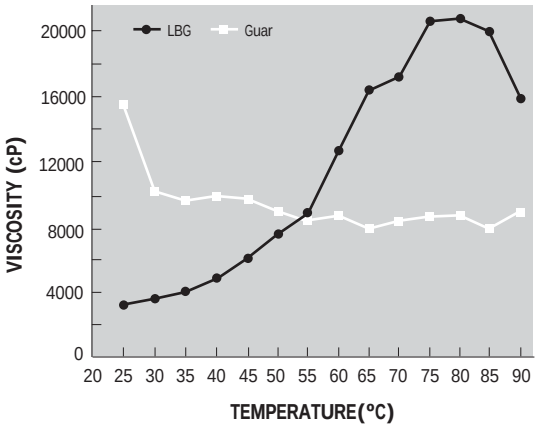

Figure 3
Viscosity of stirred guar and LBG.

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3

Using the RVA™ to define the influence of α-amylase activity and starch characteristics on the pasting properties of wholemeal

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INTRODUCTION

Recent studies have shown that low FN values don't always correspond to high levels of ∝-amylase activities due to sprout damage. This could lead to the downgrading of some lots of wheat when their amylase activities are low and they would be perfectly suitable for bread making.

Wheat meal and flour pasting properties can be influenced by parameters other than ∝-amylase activity. Variation in wheat starch characteristics, (composition, structure) could also lead to low FN values.

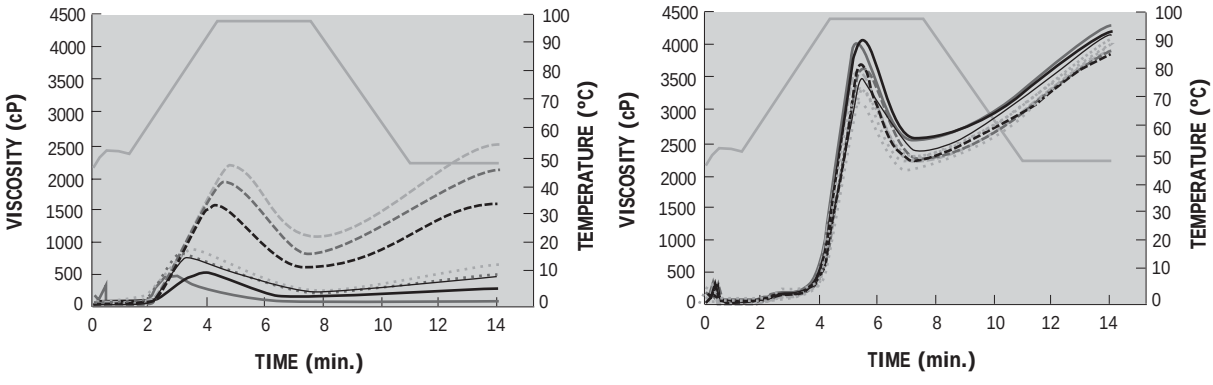
In this study, the RVA is used to investigate the contribution of starch and ∝-amylase activity on wholemeal and corresponding starch pasting properties.

MATERIALS AND METHODS

- 10 wheat varieties were selected on the basis of their baking quality, precosity and sprouting resistance and grown under the same conditions.
- Ground in a Cyclotec mill with a 0.5 mm sieve. Starches were obtained by wheat flour fractionation based on a pilot "Batter" procedure.
- Tested on an RVA-4 using ICC Method No 162 and Std 1 profile using water and 2 mM $AgNO_3$ solution for the ∝-amylase activity inhibition. Sample weights were corrected on the basis of 4 g at 14% moisture for wholemeal and 3 g for starch.
- ∝-amylase activities determined by the Amylazyme method (Megayzme) and expressed in Ceralpha unit/g of wholemeal.

Figure 1
RVA pasting curves of 10 varieties of wheat with distilled water (wholemeal).

Figure 2
RVA pasting curves of 10 varieties with 2 mM $AgNO_3$ (wholemeal).



RESULTS AND DISCUSSION

The 10 varieties showed wide variations in RVA pasting [PV1] (Figure 1). Enzymatic activity is not sufficient to explain the differences in wholemeal pasting properties.

RVA pasting [PV2] (Figure 2) obtained with ∝-amylase activity inhibitor are similarly different indicating the importance of intrinsic starch characteristics on the wholemeal pasting properties.

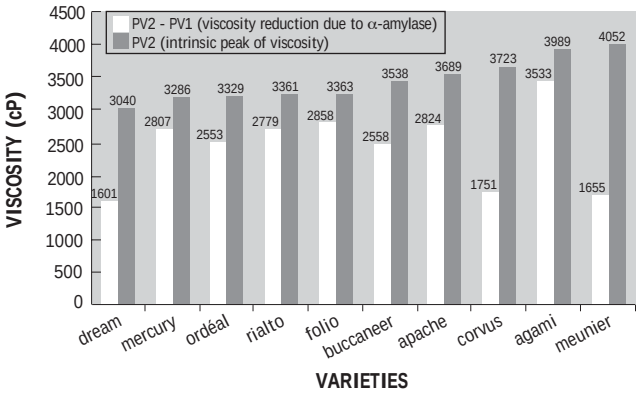


Figure 3
The intrinsic peak of viscosity and the viscosity decrease of the 10 varieties (wholemeal).

The difference [PV2-PV1] (Figure 3) represents the decrease in peak due to ∝-amylase activity.

There is a high correlation between ∝-amylase activity measured by the Amylazyme method and [PV2-PV1]/PV2 (Figure 4) confirming that amylase activity estimation in wheat with RVA requires both measurements in water and in 2 mM $AgNO_3$ solution because of differences due to intrinsic pasting properties.

Correlation coefficients between the RVA parameters of extracted starches and wholemeals confirm the impact of intrinsic starch characteristics (amylose content, granule size distribution ...) on the wholemeal pasting properties. (Figure 5.)

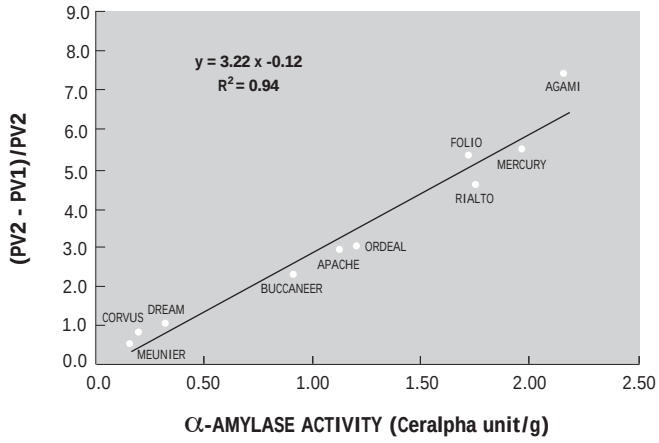


Figure 4
Relationship between (PV2-PV1)/PV2 and the α-amylase activity of the 10 varieties.

CONCLUSIONS

This study demonstrates that the pasting properties of wholemeal are influenced by both ∝-amylase and the intrinsic characteristics of the starch.

Use of two RVA measurements, one using water and one using a 2 mM $AgNO_3$ solution as enzyme inhibitor, produces a better sorting of wheat in order to fulfil specific end-use requirements (mainly the starch properties).

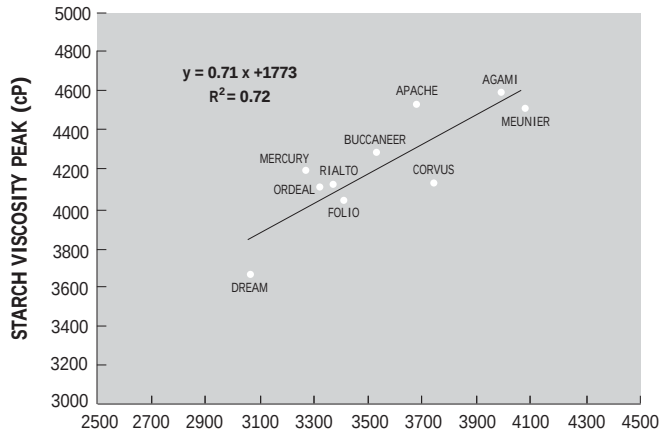


Figure 5
Relationship between the wholemeals and the starches intrinsic peak of viscosity (PV2).

ACKNOWLEDGEMENTS

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RVA™ STIRRING NUMBER (SN) METHOD

Accepted by **AMERICAN ASSOCIATION OF BREWING CHEMISTS** *as Standard Method*

Sprout Damage in Barley

Summary of Publication no. J-2004-0107-020, 2004 American Society of Brewing Chemists, Inc.

During 2003, the sprout damage sub-committee of the American Society of Brewing Chemists tested nine Canadian and United States (US) sample pairs of barley with a wide range of Stirring Number values.

METHOD

Distilled water (25.00 ± 0.05 mL) and ground sample (4.00 ± 0.01 g) was tested in the RVA using the standard Stirring Number (SN) method and the viscosity (cP) was recorded at 3.0 minutes as the SN.

In the SN method, the water and ground grain is heated to 95ºC to gelatinise the starch to form a viscosity peak. The viscosity peak breakdown is accelerated if α-amylase is present, thus the lower the SN value the greater the α-amylase. The relationship between α-amylase and SN is logarithmic.

RESULTS

- Mean SN values for the sample pairs were 78.4 to 1960.7 cP %. (<1440-1800 cP may be pre-germinated.)
- Repeatability coefficients of variation (cv_r) were 1.14 to 13.40.
- Reproducibility coefficients of variation (cv_R) were 8.94 to 28.86%. (Largest for moderately to highly sprouted samples.)

CONCLUSION

- Reproducibility values (R_{95}) and repeatability values (r_{95}) indicate the chance of a highly sprouted sample being judged as acceptable and an acceptable sample being judged as sprouted is negligible.
- R_{95} and r_{95} values indicate very good intralaboratory repeatability for SN.

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