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RVA world

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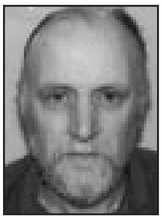
Frost, Late Maturity α-amylase and Australian Wheat Receival Standards



Notes from a paper presented by John Dines and Terry Taylor, Goodman Fielder — Milling Australia, at 49th Australian Cereal Chemistry Conference

Over recent years the design of larger and more automated food plants has lead to a narrowing of the 'acceptable tolerances' of all the ingredients used in food applications; wheat and flour supplied to these customers and processes is no different. This situation has lead to the miller becoming aware of the relationship between wheat characteristics on intake at the mill and the production of consistent, high-quality, finished products which are 'fit for purpose'.

Experiences of 1998-99

There are two circumstances which occurred during the harvest in Australia's Murrumbidgee Irrigation Area (MIA) of soft wheat in 1998-99:

• Environmental conditions (frost) in southern NSW resulted in major biochemical changes to ripening wheat in this area.

• The variety Triller — a soft biscuit wheat grown for a specific end use was found to have low falling number despite having no rain or frost (weather) damage. Other soft varieties (particularly Rosella and Bowie) were also affected. Further, in recent years the parentage of some Australian wheat varieties has included imported germ-plasm *(Cleo-inia)* in an effort to increase yield. It has been found that the influence of mild ripening conditions at harvest resulted in one of these varieties, namely Triller, expressing LMA (late maturity α-amylase).

Receival Standards and the Needs of Millers

An area of concern to grain purchasers (specifically flour millers) is how well receival standards compare with the end user requirements with respect to quality (specifically starch gelatinisation properties). Receival standards employ the falling number test to evaluate soundness of the grain with respect to degraded starch due to enzyme activity during germination. The majority of end users do not use the falling number test as a laboratory method but employ starch gelatinisation properties as a measure of 'fitness for purpose'. (It is interesting to note the number of retail products which require high starch pasting characteristics in the wheat or flour used in their manufacture.)

It was observed in the 1998-99 harvest that there were a number of situations where starch pasting peak height could not be accurately predicted from the falling number of the grain. That is, falling number values were not sufficient to determine if grain was acceptable for a particular end use.

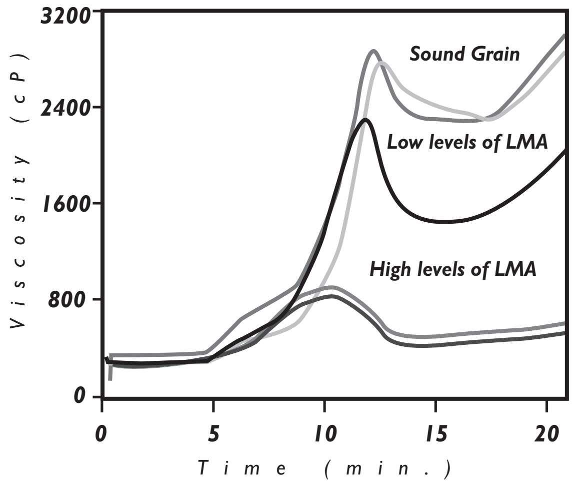
Two situations where this occurred were:

• Rain-affected grain from central Queensland.

• Soft varieties from southern NSW which had been either frost damaged or exhibited LMA.

How The RVA-4 Helped

The RVA-4 was used to help overcome these problems. Every load of grain out-loaded from suppliers was tested for peak height using a modified starch pasting profile before binning at the mill.



Conclusion

The falling number test does not correlate well enough with starch pasting peak viscosity data to allow the falling number test to be used as a means of determining the suitability of grain, with respect to gelatinisation properties, for a specific end use. The RVA-4, utilising a rapid modified starch pasting profile, has been shown to meet this requirement during the 1998-99 harvest.

In this issue

Rapid Visco Analysis of Protein Isolates

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The Newport Scientific Rapid Visco Analyser (RVA) was developed to measure the pasting properties of wheat flour and starches, and has established itself as a most useful tool in this area. The instrument can also be used to examine the effects of thermal processing on the functional properties of protein. This study describes Rapid Visco Analysis of commercial protein isolates, obtained from soybean, whey and wheat.

These isolates are representative of an expanding range of proteins available for developing new food products. Soy and whey protein isolates have particularly good nutritional attributes, and are available with alternative specifications to provide a versatile range of functional properties. Food products which incorporate protein isolates include baked products, beverages, gelled foods, and frozen desserts.

This study used a Rapid Visco Analyser to examine the effects of thermal processing on representative protein isolates used in the development of new food products. The RVA provides for direct monitoring of viscosity in the temperature range of 0-95°C, and enables gelation to be studied using linearly ramped heating and cooling conditions. Variables which can be controlled include rate of heating, time, shear rate and rate of cooling.

Various soy protein isolates were obtained from Soy Protein Technology International and Archer Daniels Midland. Whey protein isolate was obtained from New Zealand Dairies. Protein slurries were prepared by mixing the pre-dried protein isolate with deionised water at room temperature. The RVA was used to monitor viscosity and temperature changes according to preprogrammed heating and cooling profiles. The RVA has been applied to both single component systems and mixed protein systems (Haydon and Hosken 1999).

Protein isolates can be used to form gels and films. In the case of soy, gels were formed in 375 mL cans and processed at 120°C for 20 minutes. Gel strength was determined through a compression test on the canned gel in a Lloyd Texture Analyser. Films were formed from degassed aqueous slurries by pouring onto glass plates and drying at room temperature under low vacuum. Film thickness was measured using a Mitutoyo micrometer with precision of 2 micron.

The concentration sensitivity of thermal gelation for the various isolates was compared directly through an RVA test profile. RVA final viscosity was the viscosity of 30 g of isolate slurry recorded at the completion of a 25-minute ramped heating and cooling program. The maximum temperature of the test was 95°C and final viscosity was measured following the cooling cycle at 30°C.

The test conditions used are shown in Figure 1. Viscosity profiles for soy, whey and wheat isolates are shown in Figure 2 and Figure 3 and concentration dependence of the final viscosity for the different isolates is clearly demonstrated.

Profile

Time	*Type*	*Value*
00:00:00	Temp.	30°C
00:00:00	Speed	960 rpm
00:01:00	Speed	320 rpm
00:04:00	Temp.	80°C
00:07:00	Temp.	80°C
00:08:00	Temp.	85°C
00:11:00	Temp.	85°C
00:12:00	Temp.	90°C
00:15:00	Temp.	90°C
00:16:00	Temp.	95°C
00:19:00	Temp.	95°C
00:30:00	Temp.	30°C
End of Test		

Figure 1.
RVA profiles for soy, whey and wheat isolates.

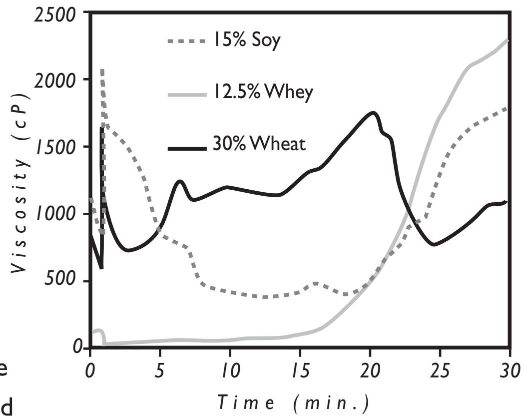

Figure 2.
RVA viscosity profiles for soy, whey and wheat isolates.

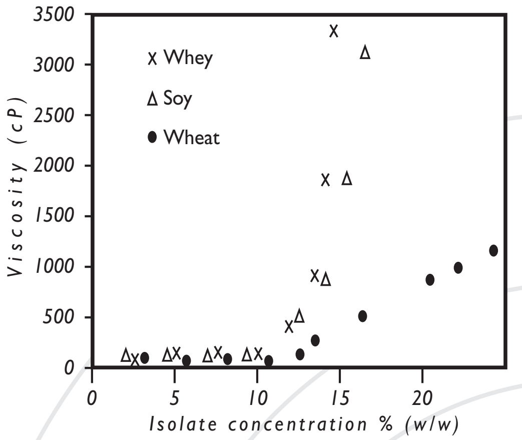

Figure 3.
Concentration sensitivity of RVA final viscosity of three protein isolates.

When concentration of protein is constant, the temperature and the amount of shear affect the final viscosity. Figure 4 shows trends in the final viscosity for the whey protein isolate and a further soy protein isolate as the maximum temperature of the RVA test is increased. The occurrence of an optimum temperature for soy isolate gels was also found to apply with canned soy isolate gels (Haydon and Hosken 1998*)*.

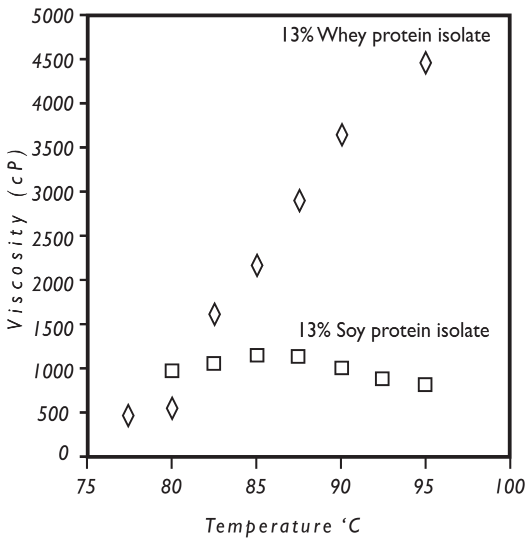

Figure 4.
Temperature effects on RVA final viscosity of 13% gelled protein isolates.

Soy isolates were used in a preliminary investigation of relationships between RVA final viscosity, gel strength and film thickness.

Figure 5 shows the value of the RVA final viscosity as an indicator of the strength of gels and the thickness of corresponding films for selected SPIs at a range of concentration levels.

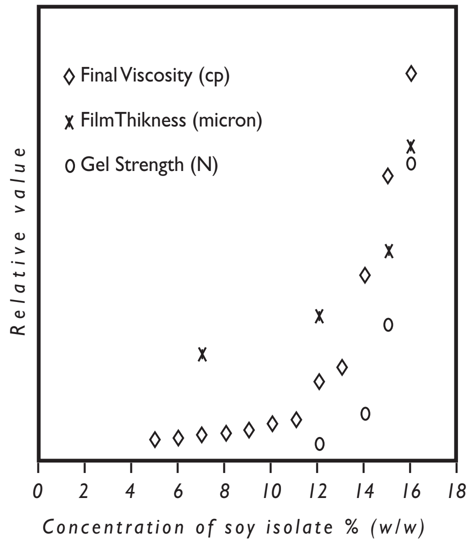

Figure 5.
RVA final viscosity, gel strength and film thickness for various concentrations of a soy protein isolate.

The details of thermal gelation vary with the kind of protein used, and reflect the unique primary structure of the particular protein isolate and the kinds of bonds which contribute to the secondary and tertiary structure of the proteins. We have found that thermal, ionic and pH effects are especially important to the gelation of proteins. The unique way each kind of commercial protein isolate is prepared impacts on bonding arrangements and the behaviour of isolates in food processing operations.

The RVA is useful for simulating the effects of thermal processing and changes in environmental conditions on the rheological properties of food proteins. When environmental conditions favourable to gelling are created, a progressive cross-linking mechanism takes place. Increasing clusters of associated chains develop until a critical point is reached where the network spans the whole sample volume. The gel point and the network are accompanied by a sharp increase in viscosity.
The network continues to further increase in elasticity and stiffness until a quasi-stable state is attained, provided there are no interfering effects such as syneresis. Gel cures may be followed by the measurement of viscous and elastic properties with time.

It is possible for mixed protein systems to give spurious results. Proteins vary in sensitivity to a large range of additives, contaminants and environmental influences, and these factors need to be considered when interpreting the responses of a mixed protein system.

Protein gels are also liable to tear above critical concentration levels, although this problem was avoided by working below the lowest concentrations at which this occurs. The whey isolate used was most susceptible in this regard, exhibiting tear characteristics in the RVA curve at concentrations above approximately 13.7%.

We have found the RVA useful for obtaining information on the way in which protein isolates respond to heat and interact with other ingredients used in formulating new food concepts. This information is useful in determining optimal combinations of ingredients in relation to processing constraints, rheological outcomes and minimisation of ingredient costs.

Haydon, R.M. and Hosken, R.W., 1999. Assessment of protein systems by the Rapid Visco Analyser. 10th World Congress of Food Science and Technology, Sydney, p. 21-23.

Haydon, R.M. and Hosken, R.W., 1998. Thermal gelling of soy proteins during canning. 10th Australian Soybean Research Conference, Brisbane, p. 175-179.

Foss North America Seminars

Foss North America has completed their series of viscosity seminars for 2000. Targeted towards food and starch industry professionals, the seminars featured industry speakers such as Tony Bello of Ebiita Consulting and Paul Whalen of Whalen Consulting.

Speakers focused on introducing RVA techniques for ready-to-eat breakfast cereals such as flakes, puffs and shreds, baked and fried snacks and modified starches. Practical applications case studied included 'reverse engineering' of extruded foods and feeds, improving the quality of food products by utilising the starch viscosity profile and applying the RVA in a processing environment.

Novel RVA applications — including cornflour, wheat starch, potato granules and flakes, soy flour, milk protein, gluten, semolina and pasta — were also explored.

You can find more information about these applications, or the Foss North America RVA seminar program, by contacting:

http://www.fossnorthamerica.com
or
http://www.newport.com.au

Errata

The graphs Figure 2 and Figure 3 on page 3 of *RVA World 15* are incorrect. The correct graphs are:

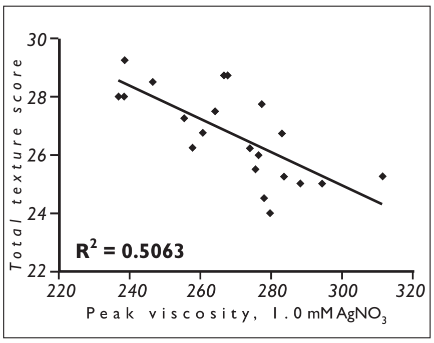

Figure 2.
Relationship between total texture score and peak viscosity assessed in 1.0 mM $AgNO_3$.

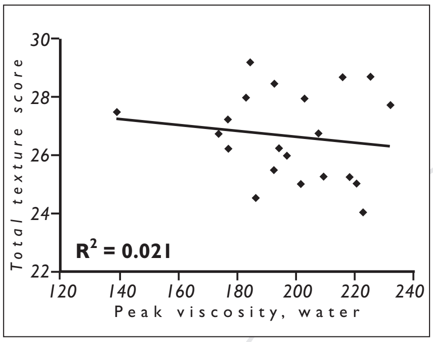

Figure 3.
Relationship between total texture score and peak viscosity assessed in water.

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