

# Variation in Starch Properties of Some Schooner Barleys

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The barley variety Schooner has been, and still is, one of the major malting varieties grown in Australia. However, on occasions it has been found not to give the malting quality expected from indicators such as protein content. About 15 years ago, the variability became obvious, with the then NSW Barley Board receiving complaints about the lack of correlation between germination and true maltability. Samples of Schooner of the same protein content and grain size would also often malt differently if sourced from different areas. The poor correlation between germination and maltability was confirmed by scientific studies (Taylor, 1987). In addition, the relationship between protein content and malting potential was shown to be more similar to that of feed barleys rather than malting barleys. For example, in samples from the 1985 harvest the reduction in extract for each percent increase in protein content was 1.25% and 1.21% for Triumph and Clipper, respectively. For Schooner the reduction was 1.84% and for O'Connor 2.24% (Glennie-Holmes, 1987).

The reason for this variation has not been determined. However, it is possible that it is related to the ability of the starch to be degraded to soluble carbohydrate. Starch has been isolated from a number of varieties and breeding lines and its properties have been studied. The results of this testing are reported here.

## Materials and Methods

Samples of the barley varieties Kaputar and Schooner, and the breeding lines WB136 & WB185 were obtained from trials grown at nine sites - Coonamble, Dubbo, Lowesdale, Moree, Bogan Gate, Tottenham, Wagga Wagga, Walgett and Yanco. The barley was milled in a Quadrumat Junior laboratory mill (Brabender, Duisburg, Germany) adjusted for milling wheat. The flour was collected and starch was extracted from the flour using the method of Schulman and Kammiovirta (1991). After washing with water, the starch was freeze-dried before further analysis.

Amylose content was measured by the method of Batey and Curtin (1996). Pasting viscosity was measured using the Rapid Viscoanalyser (RVA) (Newport Scientific, Warriewood, NSW). The temperature profile was: hold at 50°C for 2 min, heat to 95° over 6 minutes, hold at 95° for 4 min, cool to 50° in 4 minutes and hold at 50° for 4 minutes. The test used 3.00g starch in 25.00 mL water (Batey *et al*, 1997a). Starch granule size distribution was determined using a Malvern particle size analyser Model 2600c (Malvern Instruments, Malvern, UK). An indication of the degree of branching was obtained by  $\alpha$ -amylase digestion as described by Batey *et al*, 1997b).

Thermal analysis was carried out on a Pyris™ 1 Differential Scanning Calorimeter (DSC) (Perkin Elmer, Norwalk, CT, USA). Starch and water were accurately weighed to form a mixture containing 1 part starch: 2 parts water. Approximately 40 mg of this mixture was accurately weighed into a stainless steel can and the can was sealed. The can was then heated

from 20°C to 180°C at the rate of 10°/minute, held at 180° for 1 minute, and cooled to 20°C at 10°/minute. The data was collected and processed using Pyris™ software.

## Results and Discussion

Neither the degree of branching nor the amylose content varied much between samples. The proportions of the oligosaccharides of different chain lengths showed almost no variation in different samples. This confirms the observation made with a larger range of varieties and lines that barley starch shows little variation in the number of branches close together in the amylopectin. While the amylose content did range from 19 to 23 percent, the variation between samples of the same line grown at different sites was found to be small.

The RVA pasting viscosities showed more variation (Table 1). There was little difference in the range obtained for different lines, with the exception of Schooner. With the other lines, the environment may have affected the viscosities, but it would seem that the effect was fairly uniform across all lines. In the case of Schooner starch, the peak viscosity of one sample was significantly higher than the remainder (558 RVU as against a range of 291-382 for the other 8 samples). In four of the samples, the final viscosity was very high, to the extent of going off scale at normal concentration. The sample with high peak viscosity was not one of these with high final viscosity. One of the samples of WB136 also had a high peak viscosity (569 RVU compared to 317-347 for the rest) but its final viscosity was within the range of the other samples of this line.

**Table 1.** Viscosity of barley starches.

	Peak viscosity	Final Viscosity	Trough
Kaputar	325 - 330	280 - 316	109 - 151
Schooner	291 - 558	273 - 617	60 - 123
WB136	317 - 569	225 - 302	73 - 144
WB185	288 - 379	272 - 325	110 - 150

Particle size analysis also shows some differences between lines for the proportion of granules under 10µm in size (Table 2). Kaputar had a very narrow range of values (23.3 -24.3%) while the other lines showed a difference of about 7% among sites. However, Kaputar was only available from three of the sites, while the other lines were available from all sites. For the three sites from which Kaputar was obtained, Schooner, WB136 and WB185 showed a range of values for granules under 10µm of 22.6 - 25.0%, 16.1 - 22.1%, and 23.4 - 26.9%, respectively. These were all greater than the range for Kaputar.

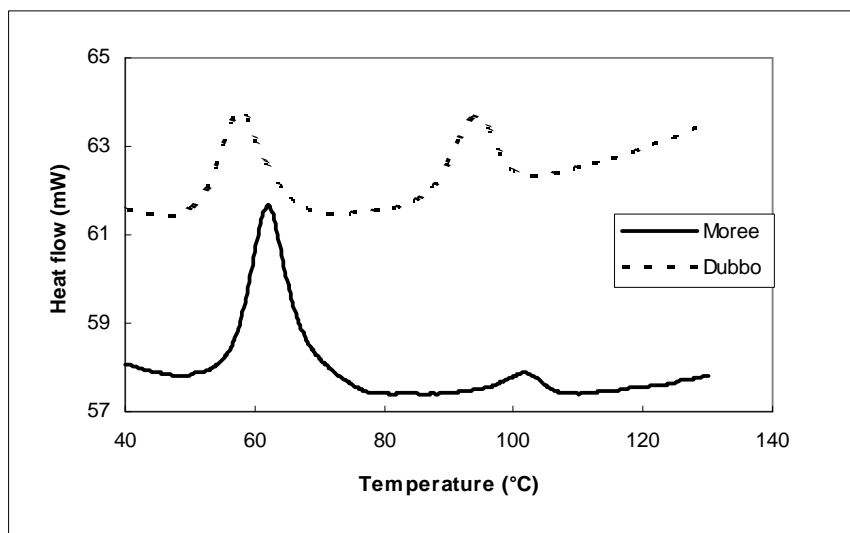
**Table 2.** B-granules in barley starch.

Variety	% granules under 10µm
Kaputar	23.4 - 24.4
Schooner	18.0 - 25.0
WB136	16.1 - 23.0
WB185	23.4 - 30.0

Thermal analysis showed differences in both the gelatinisation endotherm and the amylose/lipid endotherm. Results are shown in Table 3. Three samples of Schooner showed a slight reduction in the gelatinisation onset temperature, and a significant reduction in  $\Delta H$  (from 5.7 J/g to about half of that value). A comparison of two Schooner starch samples is shown in Figure 1. In the same samples, the amylose/lipid endotherm also showed a reduction in onset temperature and a major increase in value for  $\Delta H$ , from around 0.4 to 1.8 J/g. These samples were three of the ones which showed a high RVA final viscosity. However, the fourth schooner starch with a high final viscosity showed "normal" values for gelatinisation and amylose/lipid melting in the DSC.

**Table 3.** Gelatinisation and amylose/lipid endotherms of barley starches.

	Gelatinisation			Amylose/Lipid		
	Onset °C	Peak °C	$\Delta H$ J/g	Onset °C	Peak °C	$\Delta H$ J/g
Kaputar	55.9 – 56.7	61.3 - 62.4	5.0 - 5.8	95.9 - 97.5	102.0-103.1	0.4 - 0.6
Schooner	51.7 – 57.2	57.5 - 62.5	2.4 - 5.7	85.6 - 97.4	92.9-102.7	0.4 - 1.8
WB136	52.6 – 56.6	58.5 - 62.0	4.4 - 5.7	94.8 - 97.6	101.3-102.8	0.4 - 0.6
WB185	52.8 – 57.5	59.6 - 62.6	4.7 - 5.9	95.2 - 98.8	101.2-103.6	0.3 - 0.6



**Figure 1.** DSC thermograms of Schooner starch from barley grown at Moree and Dubbo.

Whilst there is no data available for these samples to confirm that these observations are related to the malting quality, there is certainly a justification in proposing a hypothesis that they are. The increased amylose/lipid peak presumably arises from increased lipid, as there was no real change in the amylose content. Therefore, any increase in the size of the DSC peak must have arisen from an increased lipid concentration. It is not unlikely that the lipid could hinder attack by enzymes during malting, thus reducing the amount of carbohydrate able to be extracted from the malt.

Further work is required to confirm whether this phenomenon is related to malting quality. If it is, it could provide a pointer to permit the selection of lines that may not have the variability in quality that is shown by Schooner.

## References

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