Effect of the sowing date on physicochemical and functional properties of native starches extracted from European soft wheat (*Triticum aestivum* L.).

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Abstract

The influence of wheat sowing dates on the starch properties is evaluated during several growing seasons (2002 to 2005). Some European wheat varieties are sowed at 2 distinct dates, cultivated in the same growing conditions and simultaneously harvested. The comparison of the 4 harvest seasons shows globally the same observations and the results of 2005 harvest are presented in this poster. A significant impact of the sowing date on the starch properties are measured for most of the studied varieties. An appropriate selection of the wheat variety and its sowing date could be valorized to emphasize starch properties researched in industrial end uses. Furthermore, these variations between the starch characteristics could lead to processing or end-products quality problems.

1. Wheat samples

A large panel of wheat varieties are screened to evaluate the impact of the sowing date on different starch samples. Wheat samples are grown in the experimental field at Lonzée (Belgium). Sowing dates are in October and December, and the harvest is in August. Standard nitrogen fertilization is applied under solid form as NH_4NO_3 (40-65-75 kg/ha) and two fungicide protections. Each sample is grown in four different plots of 16 m^2 in a fully randomised block design. Wheat kernels from 4 different plots are mixed to reduce location effect and to increase the homogeneity of the samples.

Wheat grains are milled with a Quadrumat senior mill (Brabender, Duisberg, Germany).

2. Starch isolation

Starches are isolated by 'Batter' procedure from 2.0 kg white flour (Figure 1).

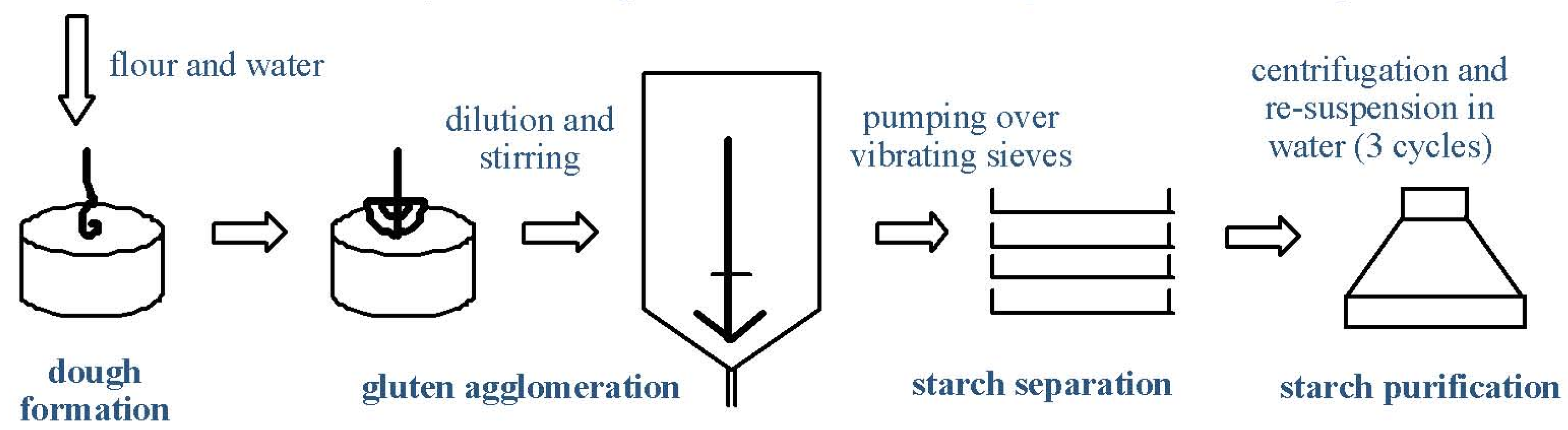

Figure 1: Starch isolation by Batter procedure

3. Granule size distribution of starch

Wheat starch contains two types of granules: large A-type starch granules (10-35 µm), disk-like or lenticular in shape, and small B-type starch granules (1-10 µm), roughly spherical or polygonal in shape (figure 2).

Particles size characteristics of starches are determined by using a laser granulometer (Malvern, Worcestershire, UK), based on the principle of laser light scattering. Contribution of the B-granules population (<10 µm) to the total volume are given in Figure 2.

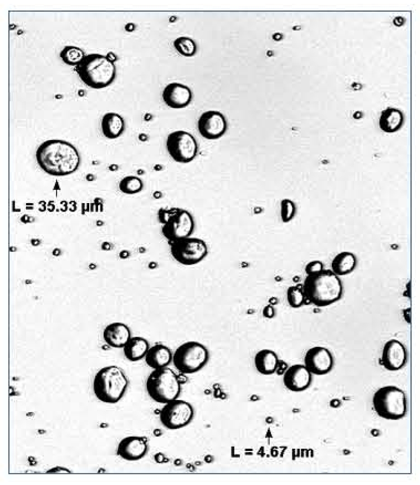

Figure 2: Wheat starch granules

The percentage volume of small granules ranges from 10 to 33%. These variations in relative proportions of the starch A- and B-granules may result in differences in chemical composition that affect the functionality of the starch. For example starch granule size has been related to the pasting properties of starch, *alpha*-amylases susceptibility of starch, rheological properties of dough, baking characterisics and compositional differences.

An effect of the wheat sowing dates on this starch characteristic is observed:

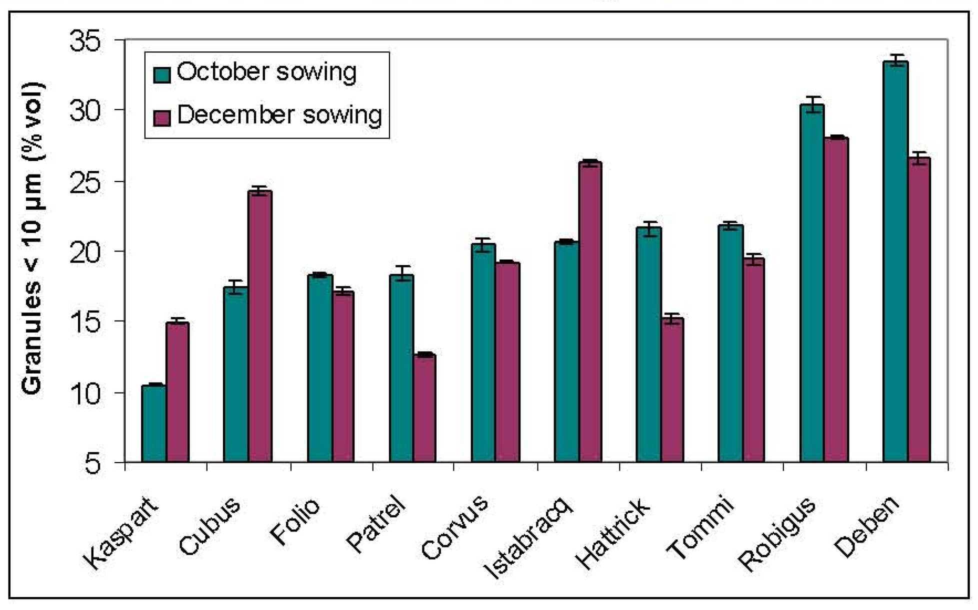

Figure 3: Proportion (in volume) of small B-granules in relation with the wheat variety and the sowing dates

for most of the varieties, the contribution of the small granules (<10µm) to the total volume is lower with later sowing dates (Figure 3).

Furthermore, the lowest and highest values are associated with Kaspart and Deben, two varieties with a low bread-making quality. This specific criteria of wheat classification could not be associated automatically to a definite granule size profile of starch.

4. Amylose content of starch

Starch is constitued by two glucose polymers: amylose, essentially linear, and amylopectin, highly branched. The relative amounts of amylose and amylopectin are know to influence both nutritional and technological properties of the starch such as its susceptibility to enzymatic hydrolysis, and its gelling and pasting behavior.

The apparent amylose content is determined by iodometric method.

Amylose contents vary from 25 to 27,5% between the different samples (Figure 4). The sowing dates influence slighly this starch characteristic: for most of the varieties, a higher amylose content is associated with later sowing dates. This observation is correlated to the lower proportion of B-granules found in these samples, confirming that amylose content is higher in large granule.

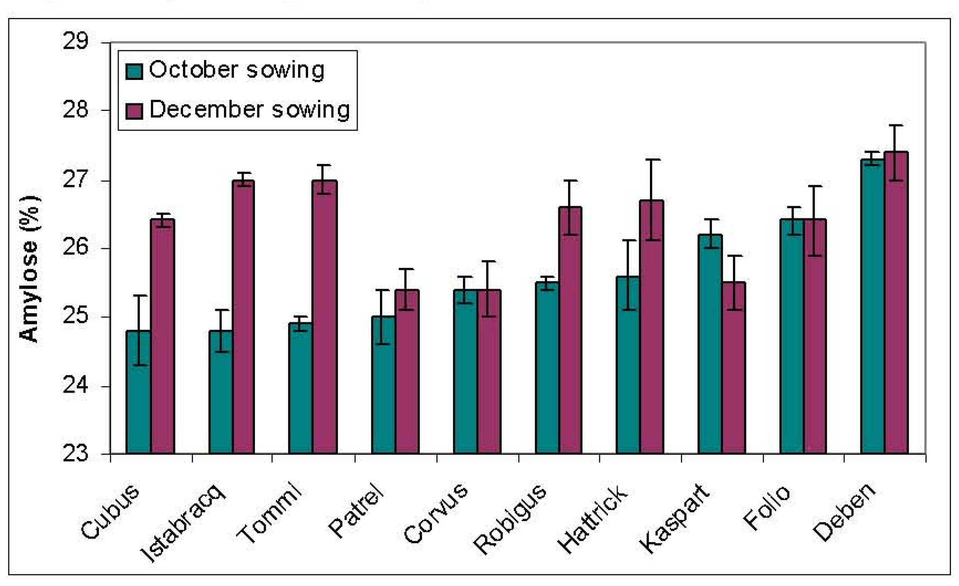

Figure 4: Amylose content in relation with the wheat variety and the sowing dates

5. Damaged starch

Damaged starch values are determined amperometrically by the Chopin SD4 method (Villeneuve-la-Garenne, France) based on the absorption kinetics of iodine. The level of the damage varies with the severity of grinding and the hardness of the wheat. Damaged starch granules hydrate rapidly and are susceptible to enzymatic hydrolysis.

With the same milling conditions, starch damages range from 11,5 to 22,3 CDU (weak to very high damages). For all varieties, an impact of the wheat sowing dates is observed on the starch damages: the values are higher with later sowing dates (Figure 5). These results may be associated to the lower content of B-granules (small and more resistant than A-granules) and to the higher amylose content (linear and more accessible than amylopectine) in the starches from later sowing dates.

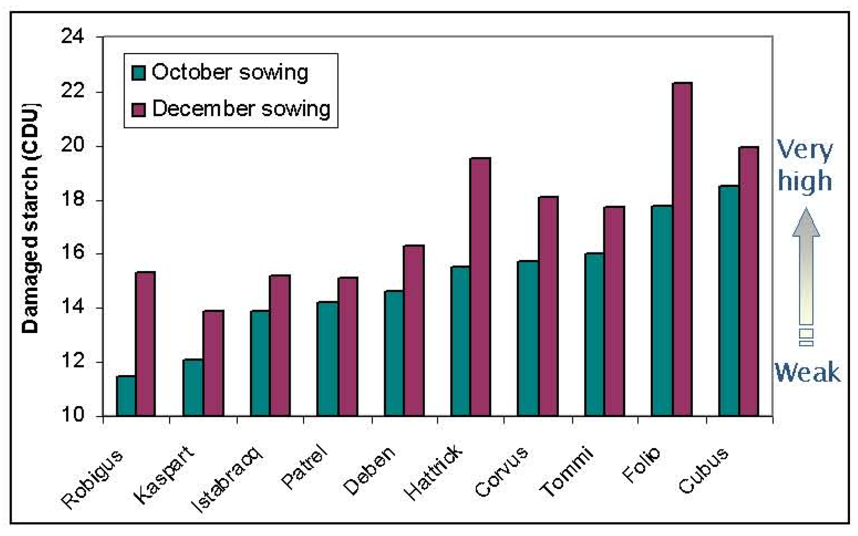

Figure 5: Damaged starch in relation with the wheat variety and the sowing dates

6. Viscosity properties of starch

Starch viscosity behavior is evaluated with a micro visco-amylograph (Brabender, Duisberg, Germany). Starch suspensions (10% dry matter) are subjected to a determine time-temperature profile (Figure 6), with addition of 2mM $AgNO_3$ to nullify *alpha*-amylase effects and facilitate comparisons between starch samples.

The viscosity peaks at 95°C vary from 257 to 355 Brabender Units (Figure 7). An effect of the sowing date is observed on the viscosity properties of the starch: for a same variety, the measurements (at 95 and 50°C) are globally lower for the starch isolated from the later sowed wheat.

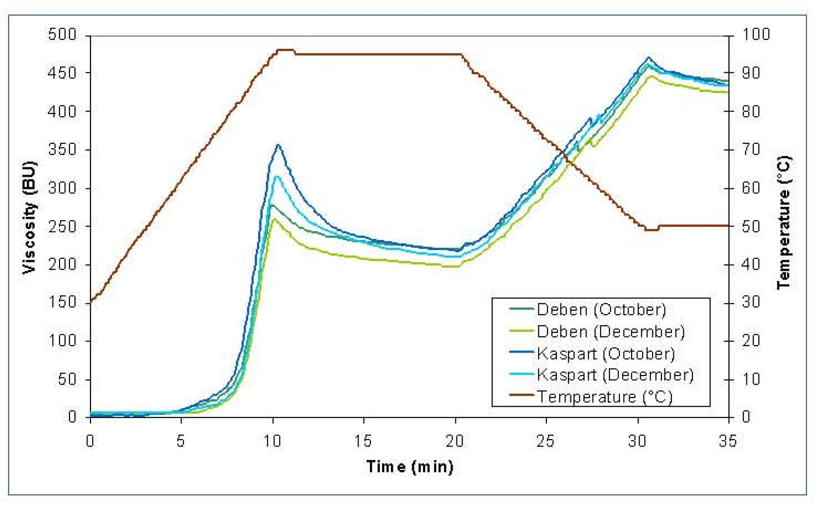

Figure 6: Brabender viscosity of wheat starches as response to the applied temperature program

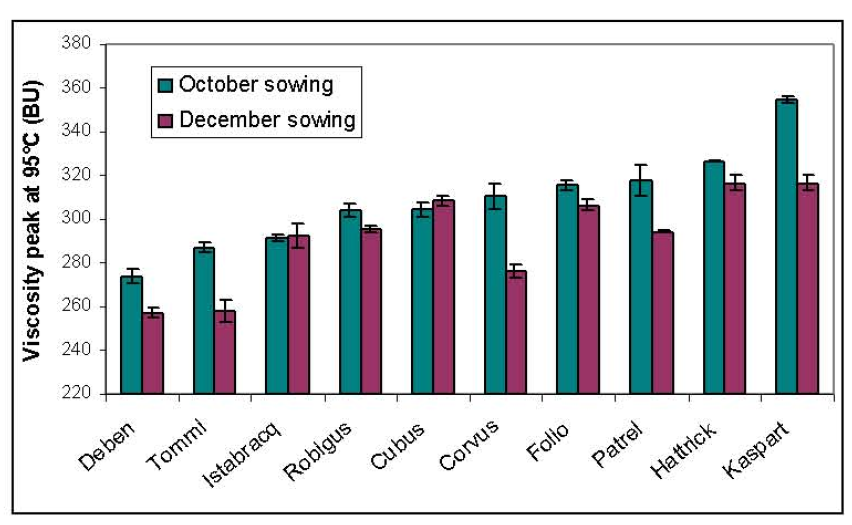

Figure 7: Starches viscosity peak measured at 95°C with $AgNO_3$, as related to the wheat variety and the sowing dates

Furthermore, the higher values are associated with Patrel, Hattrick and Kaspart, three varieties with a low bread-making quality. These varieties could then not use in the production of bread but could be valorized in suitable applications with the high viscosity properties of their starch.

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