

Size characterization of Glutenin protein polymers using Field Flow Fractionation and MALS techniques

Protein components are among the most important ingredients of bread, since they determine bread-making quality. To understand the proteins more precisely, much attention has been focused on the glutenin-fraction.

The size of these polymeric proteins appears to be basically defined by the genetically determined composition of the high molecular weight (M_W) and low M_W glutenin subunits. The amount of the most strongly aggregating/largest glutenin polymers in flour is a good measure of its bread-making potential. A strong relationship has been established between dough strength and/or baking quality and the average molecular size and size distribution of the polymeric glutenin components. However, for lack of reliable measuring techniques suitable for large molecules, the determination of the exact molecular weight distribution (MWD) of glutenins remained a problem for years.

To circumvent this problem, we used an asymmetric field flow fractionation (AFFF) technique combined with multi angle light scattering (MALS). This procedure enables us to identify variations in size distribution and conformation of functional glutenin polymers in wheat flours characterized by significantly different rheological and bread-making properties.

The results presented in this note indicate that AFFF-MALS (consisting of a Wyatt DAWN HELEOS detector, and Wyatt Eclipse AFFF separation module) provides a rapid and reliable procedure for the fractionation and size characterization of wheat polymeric glutenins (Figure 1).

A linear regression of Windex (a French test to predict the baking quality of wheat flours) against the cumulative protein content at each elution time-step, was carried out for a complete set of samples (130 wheat lines grown in six different sites). Data are depicted in Figure 2. With decreasing elution time (i.e. M_w decrease), the correlation coefficient increases until it reaches a maximum at 9.0 min, thereafter descending continuously.

These results suggest that it is the glutenin polymers eluting after 9.0 min (i.e. $M_w > 2.0 \times 10^6$ g/mol) which mainly contribute to Windex. Our results confirm predictions derived from polymer science, because they show that Windex is related to the proportion of polymeric protein with a molecular weight that exceeds a certain critical value.

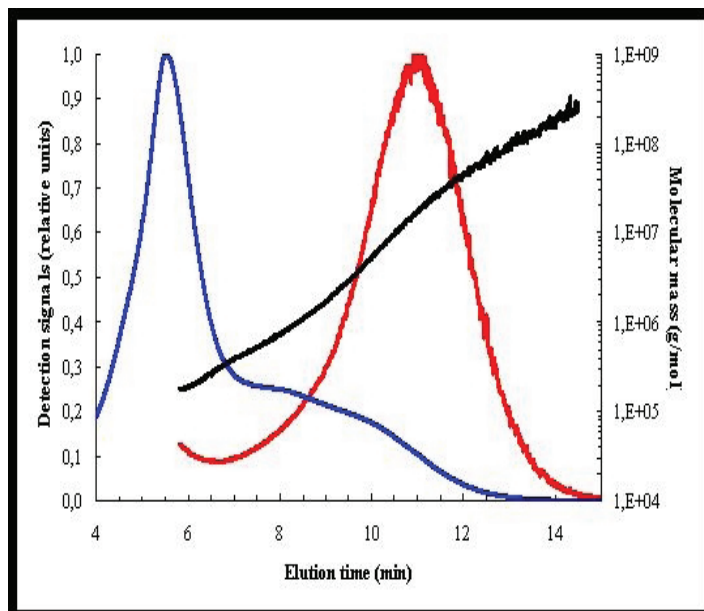


Figure 1: AFFF profile of total solubilized flour proteins. Light scattering signal at 90° shown in red, UV response depicted in blue.

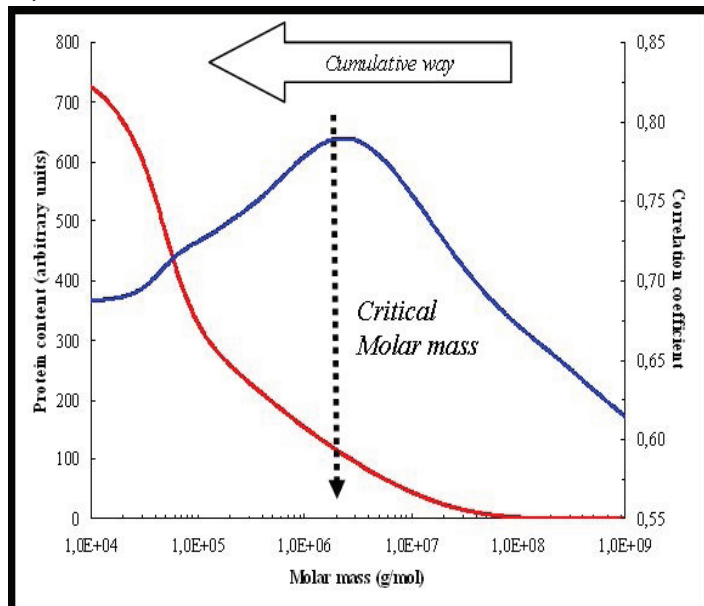


Figure 2: Evolution of correlation coefficient (Windex against cumulative protein content) as a function of molar mass (shown in blue) for a set of 780 samples. Cumulative protein content is depicted in red.

