Solubilization of Proteins with Soaps in Relation to the Bread-Making Properties of Wheat Flours

To the Editor:

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The functional role of wheat proteins, especially gluten proteins, in bread-making quality is well established. The specific viscoelastic properties of wheat dough are usually explained by the presence and the interactions of thiol and disulphide groups (Bloksma 1975, Frater et al 1960, Huebner et al 1977). Similarly, glutenin's relative insolubility is attributed to its interchain disulphide bonds. To explain the structure of glutenin or the viscoelastic properties of wheat dough, however, the involvement of polar and hydrophobic bonds were also suggested (Hoseney et al 1970; Jones and Carnegie 1971; Kasarda et al 1976; Khan and Bushuk 1978, 1979; Kobrehel and Bushuk 1977). In any case, the different biochemical analyses of flour proteins (chromatography, electrophoresis, or determination of thiol or disulphide groups) have failed so far to explain the differences in bread-making quality among different wheat varieties.

Glutenins can be dissolved in distilled water in the presence of Na salts of fatty acids (Kobrehel and Bushuk 1977, 1978). Accordingly, the solubilization of wheat proteins with soaps was very efficient. We noted in our study that the quantity and the nature of proteins solubilized with different amounts of soaps seemed to be related to the bread-making quality of the wheat varieties.

More than 20 French wheat varieties (*Triticum aestivum*) were analyzed. Flours were obtained from a laboratory mill. Proteins were solubilized by mixing 0–120 mg of soap (Na-dodecanoate, Na-hexadecanoate, or Na-octodecanoate), 2 g of flour, and 20 ml of distilled water in centrifuge tubes, stirring overnight at room temperature, and centrifuging for 15 min (32,000 × *g*) at 4°C. Supernatants were used to determine amounts of solubilized proteins (Kjeldahl method) or for electrophoresis. The protein contents of residues were also determined. Sodium dodecyl sulfate-polyacrylamide gel electrophoreses (SDS-PAGE) were performed in SDS-tris-borate buffer at pH 8.9. The proteins were reduced with β-mercaptoethanol and used for electrophoretic analyses without alkylation. Runs were made for 3 hr at 350 V. Gels were stained with Comassie Brilliant Blue R and destained with distilled water.

Distilled water dissolves about 20% of total flour protein. Addition of soap increases the amount of dissolved proteins in a nonlinear manner. At low soap concentrations, little or no additional protein is solubilized; further addition of soap causes a sharp rise in the amount of dissolved protein. After the amount reaches a maximum, a slight decrease can usually be noticed. Under these conditions, 90–95% of total flour proteins can be extracted. Complete extraction usually requires two or three additional extractions.

Less soap is necessary to solubilize the maximum amount of proteins from wheat varieties of poor bread-making quality than from varieties of good quality. Results with different soaps were similar but not identical.

SDS-PAGE analyses show that at lower soap concentrations, protein containing subunits with molecular weights higher than about 90,000 are not extracted. Some high molecular weight polypeptides are extracted at all soap concentrations, however, regardless of the wheat variety analyzed. These give very faint bands. According to these preliminary results, more soap is necessary to solubilize high molecular weight protein subunits from wheat varieties of good bread-making quality. Figure 1 illustrates these findings. In the case of Magdalena, a variety of very good bread-making quality, about 90 mg of Na-hexadecanoate was required to solubilize proteins containing high molecular weight subunits; in the case of Vilmorin, a variety of rather poor bread-making quality, only 60–70 mg were required.

To compare varieties with different breadmaking qualities, only the first protein extractions were used for electrophoresis.

If only high concentrations of soaps are used to solubilize proteins, some differencies can be noticed between varieties, particularly when comparing their high molecular weight subunits. However, the bread-making quality of the varieties is not deducible from the presence or absence of one or more protein subunits. Orth and Bushuk (1972), comparing the electrophoretic patterns of protein groups of wheat varieties with different bread-making qualities, reached similar conclusions.

All our results lead to two important observations: 1) Bread-making quality seems to be related to the nature and the strength of the preexisting bonds between the flour proteins. These seem to be polar and hydrophobic bonds which are sensitive to the action of soaps. Disulphide groups seem not to be involved, because soaps do not disrupt these bonds. 2) If these results are confirmed on a larger scale, a biochemical method based on the electrophoretic study of proteins could be developed for breeding purposes. Starting from the early generations, new lines could be checked and classified according to their bread-making quality. For breeding programs, however, a turbidity measurement of protein solutions,

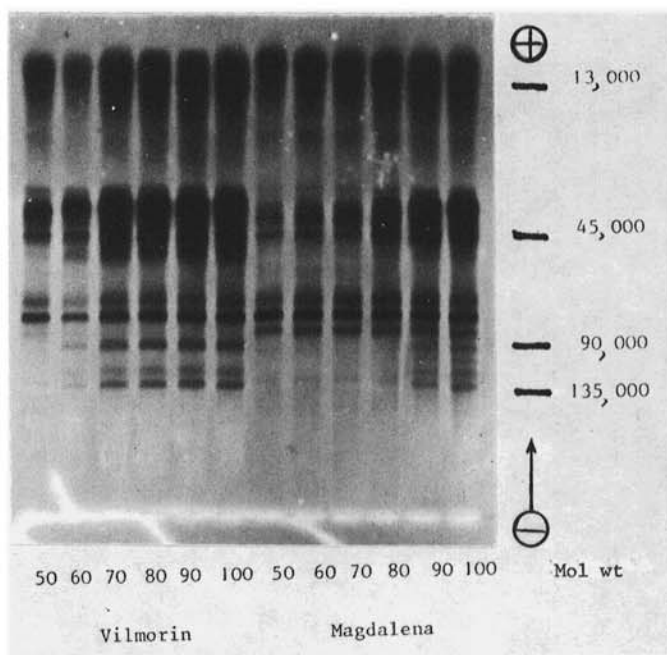

Fig. 1. Sodium dodecyl sulfate-polyacrylamide gel electrophoreses (SDS-tris-borate buffer; pH 8.9) of proteins solubilized with increasing amount of Na-hexadecanoate (50–100 mg, 2 mg of flour, 20 ml of distilled water) from the wheat varieties Vilmorin and Magdalena. Proteins reduced with β-mercaptoethanol.

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which is a much more rapid test than electrophoresis, may be sufficient. All these possibilities are being investigated.

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