THE SOLUBILITY OF WHEAT GLUTEN

by

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The main difficulty in the study of wheat gluten, and generally in that of many proteins from cereals, is their insolubility. An important advance was made when it was shown by OSBORN[1] that part of the gluten is soluble in 70% ethanol (gliadin). The remaining fraction, called glutenin, has so far been solubilised in $N/20$ NaOH, but the very turbid solution obtained by this drastic procedure does not give a molecular dispersion[2]. Although a high concentration of sodium salicylate (12%) is a better solvent for gluten, the dissolution is far from being complete and the adsorption of this reagent at the surface of the protein is an obstacle to the physicochemical study of the dissolved proteins[3,4].

The present work has been undertaken to understand, at the molecular level, the mechanical properties of the gluten and dough. With the purpose of studying the whole gluten, the first aim was to solubilise completely the protein without denaturation. The gluten used in this work is prepared from a flour of Manitoba V*. The following results were obtained:

1. By lyophilisation of the gluten, it is possible to store it without denaturation, oxidation or proteolysis and this procedure allows reproducible and quantitative results.

2. About 50% of the gluten is solubilised under slow mechanical motion in water plus an equal volume of pyridine, dioxan, acetone or ethanol. These assays, as all the following, are made with about 1 g of lyophilised gluten for 100 ml of solvent.

3. An almost complete solubilisation may be reached in the same mixtures with vigorous stirring in a Waring blendor. From this solution, the gluten can be reprecipitated without apparent alteration of its original mechanical and solubility properties.

4. The solubilisation of gluten in water with the Waring blendor is variable (from 3 to 50%). At pH 11, an aqueous solution can be obtained. The proteins of this solution, kept at ordinary temperature, undergo modification of their solubility and mechanical properties, but this transformation is negligible at 0° C.

5. The variability of the solubility of gluten in water is probably the result of the oxidation of the protein. This interpretation arises from the fact that *gluten is rapidly and completely dissolved in reducing solutions* ($M/100$) *at pH 11*, at 0° C under slow mechanical motion. The solubility in water at pH 11 under the same conditions varies with the sample (*e.g.* 30% of the total gluten). The reducing substances used are: sodium sulfide, cyanide, cystein, thioglycolate and ascorbic acid. The precipitation at pH 6 of the reduced proteins shows that the mechanical properties (elasticity) of the original proteins is lost.

Electrophoretic studies with these solutions are now in progress.

From this preliminary study, it is already possible to conclude that the solubility of gluten is typical of molecules with a low content in ionisable groups: the glutamic and aspartic residues are amidated[5,6]. The reaction toward reducing agents shows the essential role of the –S–S– groups in the mechanical properties and it is likely that this is a major factor in the diversity of wheat and explains the beneficial action of oxidants in the treatment of flour[7,8].

A detailed report on this subject will be published soon.

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