Starch gelatinization in pasta cooking : differential flux calorimetry investigations

Introduction

Pasta cooking conditions were simulated in a differential flux calorimeter. The profile of the endothermic starch gelatinization peak was observed to directly describe the process according the first-order kinetics. Isothermal calorimetry provide much more reliable results than do other traditional approaches allowing here assessment of the gelatinization kinetics and simple thermodynamic treatment.

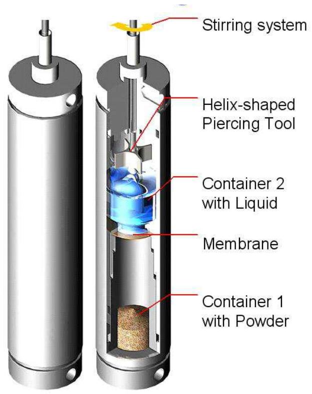

Figure 1 – Membrane mixing cell

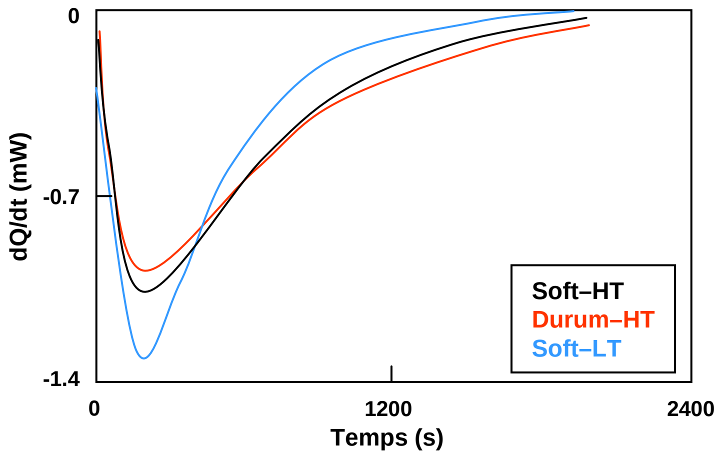

Figure 2 – Calorimetry scan (95°C) of different types of pasta

Experimental

To simulate the actual cooking conditions, a mixing cell was used (Fig. 1). An aluminum membrane separated the upper from the lower part of the sample and reference cells. A piece of spaghetti 1 cm long (60-100 mg) was set within the winged edge of a vertical stirrer that can be held in the upper part of the cell. Below the aluminum membrane, the cell was filled with 5 ml of water for a pasta-water mass ratio somewhat larger than the minimum required for gelatinization and traditional cooking. The same situation, except for the presence of starchy material, was repeated for the reference cell. When thermal equilibrium was achieved throughout the system, the two stirrers were simultaneously pushed down to pierce the membrane ; at the same instant, the calorimetric signal was recorded.

Results

Figure 2 shows the behaviors of the various kinds of pasta . The corresponding K values (x 10-3s-1) at 95°C are 1.631, 2.000, and 2.970 for durum-HT, soft-HT, and soft-LT, respectively. These values agree with the traditional experience of longer cooking times for durum-HT and can be justified by the classic observation of different network structurization and by the influence of the drying conditions used in the industrial process (Resmini et al 1988, Piazza et al 1990b). Calorimetric scans performed at various temperatures were treated in the same way. If these data are worked out according to the Arrhenius relationship, K = Koexp (-Ea/RT), an " activation energy " can be calculated : Ea = 61.4 kJ/mol which can be compared with some data in the literature (Lund 1989).

Adapted from: M.Riva, L. Piazza and A. Schiraldi, Cereal Chem. Vol 68, 622-627, (1991).

C80
Ambient to 300°C