Starch gelatinization during baking

Starch gelatinization is a necessary process for obtaining a normal bread crumb structure. Starch gelatinization means an increase in the viscosity of the continuous phase of the dough or batter, and in this way bread or cake foam structure is stabilized during the last part of the oven step. Moreover, the fixation of the crumb structure also means that the volume expansion is stopped. It has been speculated that starch with a high gelatinization onset temperature is beneficial for the volume expansion – there is more time for the volume increase before the fixation of the crumb starts.

There are many methods to study starch gelatinization, and one of the most used is differential scanning calorimetry (DSC). In this method it is possible to get information about the temperature range for the gelatinization process and the enthalpy. Moreover, the presence of amylose-lipid complexes might also be investigated. The influence of different additives can be studied, as well as the behaviour of wheat flour and extracted wheat starch. Different heating regimes might be employed, and it is known that the gelatinization process is not in equilibrium unless the heating rate is extremely low.

In a recent study we found that the inclusion of a holding step at 35ºC (corresponding to fermentation during baking) before the heating in the DSC greatly affected the subsequent gelatinization process. It is known that holding at temperatures slightly below the gelatinization onset temperature (i.e. around 50 ºC) will cause annealing, and thus increase the gelatinization temperature range for a later gelatinization process. However, holding at 35 ºC did not cause annealing, instead the gelatinization enthalpy was greatly reduced, as well as the gelatinization peak temperature and the temperature range. The appearance of the transition endotherm was completely changed compared to the appearance without a holding period.

These findings were quite surprising, and have not been previously reported. It is therefore necessary to look into the relevance of the pre-heat treatment for the subsequent gelatinization process in some more detail. In this Master thesis work the gelatinization behaviour of starch will be investigated for wheat flour and for starch extracted from the wheat flour. Different water contents, holding temperatures and times will be investigated. The aim of the study is to explain the influence of the holding temperature on gelatinization, and the experiments will be planned so that the results can be published in a scientific journal.

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