The effects of amylose and starch phosphate on starch gel retrogradation studied by low-field 1H NMR relaxometry

Low-field Nuclear Magnetic Resonance (23 MHz) was used to study the effects of the degree of phosphorylation, the amylose content and the amyllopectin chain length distribution on gel retrogradation for a set of 26 starches, six of which were of crystal polymorph type A, 18 of type B and two of type C. The phosphate content ranged from 0 to 58.8 nmol Glc6P/mg and the amylose content from 0 to 72.1%. The starch pastes (13%, w/w) were measured before and after storage for six days at 35 degreesC. It was found that Principal Component Analysis (PCA) of the raw Carr-Purcell-Meiboom-Gill (CPMG) relaxation curves from the two measurements (day 1 and day 7) could be used as a simple, illustrative way of describing the retrogradation. Three different behaviours were identified: One group of samples (mostly potato starches) slowly changed from a soft to a more rigid gel from day 1 to 7. A second group (mostly cereal starches) formed a rigid gel already before the first measurement and changed little after that. A third group comprised a few samples containing little or no amylose aged similarly to the first group of samples, but at a much slower rate. For the potato starches, a weak negative correlation (r=-0.63) was found between the degree of phosphorylation and the difference between the LF NMR relaxation curves of day 1 and day 7.