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The Hydrotrope-Mediated, Low-Temperature, Aqueous Dissolution of Maize Starch

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Abstract : Complete aqueous dissolution of starch is notoriously difficult. A high-temperature autoclaving process is necessary, followed by cooling the solution below its boiling point. The cooled solution is inherently unstable over time. Gelation and retrogradation processes, along with aggregation-induced by undissolved starch remnants, result in starch precipitation. We recently observed the spontaneous gelatinization of native maize starch (MS) in aqueous sodium salicylate (NaSal) solutions at room temperature. A hydrotropic mode of solubilization is hypothesized. Differential scanning calorimetry (DSC) and polarized optical microscopy (POM) of starch dispersions in NaSal solution were used to demonstrate the room temperature gelatinization of MS at different concentrations of MS and NaSal. The DSC gelatinization peak shifts to lower temperatures, and the gelatinization enthalpy decreases with increasing NaSal concentration. POM images confirm the same trend through the disappearance of the 'Maltese cross' interference pattern of starch granules. The minimal NaSal concentration to induce complete room temperature dissolution of MS was found to be around 15-20 wt%. The MS content of the dispersion has little influence on the amount of NaSal needed to dissolve it. The effect of the NaSal solution on the MS molecular weight was checked with HPSEC. It is speculated that, because of its amphiphilic character, NaSal enhances the solubility of MS in water by association with the more hydrophobic MS moieties, much like urea, which has also been used to enhance starch dissolution in alkaline aqueous media. As such small molecules do not tend to form micelles in water, they are called hydrotropes rather than surfactants. A minimal hydrotrope concentration (MHC) is necessary for the hydrotropes to structure themselves in water, resulting in a higher solubility of MS. This is the case for the system MS/NaSal/H_2O. Further investigations into the putative hydrotropic dissolution mechanism are necessary.

Keywords : hydrotrope, dissolution, maize starch, sodium salicylate, gelatinization
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