

## The Role of Salts in the Food Gel Formation

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The rheological and thermal properties of sodium gellan gum solutions with and without potassium chloride, sodium chloride, calcium chloride and magnesium chloride were studied by mechanical spectroscopy and differential scanning calorimetry (DSC). At the temperature range from 30°C to 0°C, the viscoelastic behaviour of 1% gellan gum solutions without salt was typical of a dilute solution, however, that of 2% gellan gum solutions varied from a dilute solution type to a weak gel type with decreasing temperature. The behaviour of 3% gellan gum solution tended towards that of a weak gel, even at a relatively higher temperature as 25°C. Potassium ions are more effective to increase  $G'$  than sodium ions, and calcium ions are more effective than magnesium ions. The mechanism of gel formation in gellan gum with divalent cations seems to be markedly different from that with monovalent cations, because gels in the presence of divalent cations are much more heat-resistant than gels in the presence of monovalent cations. The DSC cooling or heating curves for 1% gellan gum solutions without salt showed a single exothermic or endothermic peak at around 30°C. DSC cooling curves show a single exothermic peak, with the setting temperature  $T_s$  shifting to progressively higher temperatures with increasing concentration of the added NaCl or KCl. At low concentration of NaCl or KCl, DSC heating curves showed a single endothermic peak, however with more addition of salt, the endothermic peak gradually developed bimodal character and eventually splitted into more than two distinct peaks. The onset of detectable splitting occurs at a high salt concentration. Gellan gum solutions with excessive divalent cations form firm gels on cooling to below the setting temperature, and then it was difficult to remelt them, which was quite different from the behaviour of thermoreversible gels formed in the presence of monovalent cations. The mechanism of gel formation in gellan gum with divalent cations is markedly different from that with monovalent cations.

The interaction of xanthan and glucomannan (konjac mannan, KM) has been monitored, using DSC and mechanical spectroscopy. In the presence of electrolyte, both techniques show that the xanthan conformational change shifts to higher temperatures and depends on the nature of the cation. Divalent cations give rise to a greater shift than monovalent cations. The results indicate that xanthan/KM interaction occurs at temperatures much lower than the conformational transition. The rheological properties (i.e., storage( $G'$ ) and loss( $G''$ ) moduli and setting temperature,  $T_s$ ) are greatly influenced by the presence of electrolyte. In all instances,  $G'$ ,  $G''$ , and gelation temperature are reduced when electrolyte is present, with divalent cations having a greater effect than monovalent cations. The reduction in  $G'$ ,  $G''$ , and  $T_s$  follows the lyotropic series with increasing effects in the order  $K^+ \sim Cs^+ < Na^+ \ll Mg^{2+} \sim Ca^{2+}$ . These observations are explained by the fact that electrolyte promotes xanthan self-association at the expense of xanthan/KM interaction.