# Gelation of mixture of iota and kappa carrageenan

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We will discuss the rheological properties and microstructure of mixture of native kappa carrageenan (κ-car) and iota carrageenan (ι-car) in the presence of salts (CaCl2 and/ or KCl). For κ-car solution, increasing the CaCl2 between 5 and 40 mM increased the elastic modulus (Gel) and the gelling temperature (Tg). However, further increase of the CaCl2 concentration did not lead to a further increase of the elasticity. Adding CaCl2 between 5 and 20 mM to ι-car also enhanced Tg and Gel, but in this case Gel remained constantly above 20 mM CaCl2. Mixtures of κ-car and ι-car showed a two-step gelation process at temperatures that coincided with the one of pure κ-car and ι-car solutions, respectively. However, the elastic modulus of the mixtures at low temperatures was much higher than the sum of those of the pure systems within the same conditions.

For the gelation of mixed gel in presence of both KCl or CaCl2, Gel was higher than samples with just one type of salt at the same concentration. Gel increased when increasing the fraction of CaCl2 in mixed salt up to 50%, further adding CaCl2 led to a decrease of the storage modulus. However, Tg increased gradually with increasing fraction CaCl2. At a fixed ratio of KCl and CaCl2 of 50:50, Gel of mixed carrageenan increased with increasing total salts up to 40 mM and remained the same at higher concentrations (Fig.1).

In parallel, the influence of these salts on the structure of mixed gels was studied by confocal laser scanning microscopy (CLSM). In the mixtures, κ-car and ι-car could be distinguished because they were covalently labelled with different fluorescent dyes. CLSM images show that ι-car in pure or mixed gel is distributed more homogeneously than κ-car both in presence of KCl and/or CaCl2. However, κ-car appears more homogeneously distributed in the mixed gel than in the individual gels. In addtion, κ-car in the mixed gels with mixed salts appear more homogeneous than that in presence of CaCl2. Furthermore, the tubidity of mixed systems was evaluated as a function of temperature and time. The results showed that there are synergistic effects between κ-car and ι-car in mixed gels and between KCl and CaCl2 in gels with mixed salts.



**Fig 1**. Elastic modulus of mixed carrageenan at 5-5 g/L after one hour at 5 °C as a function of total CaCl2 and/ or KCl concentration.