

Quantitative Characteristics of Sol~Gel Transition Point during Heating Process using a Simultaneous Measurement of Frequency Dependence of Viscoelastic Properties for Whey Protein and Influence of Salts on their Physical Properties.

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Summary

In the field of polymer science, recently, the mechanical sol-gel transition point had been clearly defined, but thermally induced gelling process of proteins was not yet known. Hence, the determination of critical gelling point of whey proteins was investigated.

Winter and Chambon define the critical point of sol-gel transition as follows;

$$G'(\omega) \sim G''(\omega) \sim \omega^n \quad (1)$$

$$\tan \delta = \tan (n\pi/2) \quad (2)$$

It means that the frequency dependencies of storage modulus G' and loss modulus G'' obey the power law and both moduli are given by a straight line with coincident slope in log-log plot of moduli versus frequency. At the same time, loss tangent, $\tan \delta$ is independent from frequency dependence and obeys Eq.(2).

However, on the thermal process the gelling reaction of proteins is drastically progresses. The lapse of the time of the gelling reaction can not be separated from the frequency sweep measurement. To avoid this, a simultaneous measurement of frequency dependence is applied to the whey protein isolates (WPI)~water system during heating. The simultaneous method is so-called FT-RM (Fourier Transform Rheometry), and the multi-frequency by Fourier transform composed by only even harmonics is used.

By the simultaneous measurements, the sol-gel transition points of thermal induced protein gels were successfully detected and the power index on the critical point of WPI~water systems in the presence and absence of NaCl. From the estimating results of the critical points and the indices on that for both systems, it was strongly suggested that there are differences between the gels with and without NaCl for the structure of junction zone and the associating strength of protein molecules which participate the formation of their junction zones.