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Biophysical Impacts of Ionic Strength and Salt Type on Gelation of Soy Protein Isolate

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Abstract:

This study investigates the impact of salt capacity on Soy Protein Isolate (SPI) gelation, a crucial process in food and biomaterial development. The significance of metal salts as powerful crosslinkers to form hydrogels is of interest in biomaterial science. We found that SPI gelation relies on protein denaturation and aggregation into a three-dimensional network, influenced by pH, temperature, and ionic strength. It was indicated that chloride salts can improve SPI gelation potential. The research examined the role of Li^+, Na^+, K^+, Ca^{2+}, Mg^{2+}, Mn^{2+}, Fe^{3+}, and Al^{3+} cations in SPI gel formation using three SPI concentrations (10, 15, and 20 mg/mL) at pH 2.0, heated at 85°C for varying times. Factors affecting gel formation were analyzed both separately and simultaneously, with a visual assessment conducted to determine gel formation. The results indicated that a minimum SPI concentration of 15 mg/mL is necessary for gel formation, with a minimum processing time of 4 hours. For monovalent cations, no gel formation at 50 mM occurred. In contrast, both monovalent and divalent salts enabled gel formation at concentrations of 100 and 150 mM. The gelation capability of Mg^{2+} and Mn^{2+} was more pronounced. Notably, none of the trivalent cations led to SPI gelation. These findings underscore the significance of salt type and concentration in modulating SPI gelation, providing valuable insights for applications in food and biomaterial science.

Keywords: Soy protein isolate, Gel formation, Metal salts, Crosslinker.