Precise investigation of salt effect on solubility and functional properties of soybean proteins

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Summary

Soybean proteins consit of two major components, 7S and 11S globulins. It is known that solubility, thermal stability and functional properties of both proteins are strongly affected by salt concentration. 7S and 11S globulins are composed of three subunits α, α′ and β, and five subunits of group I (G1, G2, G3) and group II (G4, G5), respectively. Investigation of the salt effect on solubility, thermal stability and functional properties of each constituent subunit of these globulins is desired. It is almost impossible, however, to isolate molecular species with a single subunit comosition from the normal soybean cultivars, since they contain many molecular species with random subunit compositions. We isolated 7S molecular species with a single subunit composition (homotrimer: α3, α′3, β3; heterotrimer: α2β1, α1β2, α′2β1, α′1β2) and 11S molecular species composed of only subunits belonging to group I or II from mutant soybean cultivars lacking one or some subunits of them.

All homotrimers of 7S globulin exhibited isoelectric precipitation at μ=0.08, although the insoluble pH ranges of α3 and α′3 were much narrower than that of β3. All heterotrimers examined here exhibited the phenomena similar to that of α3 or α′3, indicating that the extension regions which exist in α and α′ contribute profoundly to the solubility of 7S globulin. 11S species, expecially group II, were isoluble at acidic pH at μ=0.5 in contrast to 7S species which were soluble at any pH examined at μ=0.5. At μ=0.08 all species exhibited isoelectric precipitation, but the pH ranges are different between species. We discussed the reason why each species exhibits different properties, based on the distribution of hydrophobic regions and charged amino acids on their molecular surfaces.

Thermal stabilities of 11S species were almost constant at μ=0.5 in spite of subunit groups, but they decreased dramatically with the decrease of ionic strength (0.5→0.1→0.01). The extent of the decrease of in thermal stability group I species was bigger than that of group II species, and that of 11S containing both groups were intermediate of groups I and II, although the thermal stability of 7S hetero trimers was determined by the subunit with lower thermal stability. It was suggested that the quality of subunit interaction is different between 7S and 11S globulins.