The Binding Behaviour of Lysozyme with Pectin Varying in Local Charge Density and Overall Charge: Structural, Conformational and Thermal Stability of Lysozyme Within Complex

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Abstract

We examined the similarities and differences of the binding behavior of lysozyme (lys) with pectin varying in local charge density (blockwise distribution and statistical distribution of methoxyl groups, BP and SP) and similar degree of methoxylation (DM). BP which is more inclined to self-association binds lys at ionic strength *I*=0.01 and pH 5.1 forming strongly associated complex particles with average sizes much larger (10-20 μm) than that of SP. The latter formed with lys small (0.6-3 μm) complex particles or liquid droplets depending on DM. The critical *I*set and pHset values Ffor BP/lys systems, above which complexes do not form, are not sensitive to DM (approximately 0.1 and 11.5 respectively), whereas for SP/lys systems the critical *I*set and pHset values decrease significantly with increasing DM. The distribution of BP and SP within the complex particles is irregular. The binding constant and stoichiometry ratio (lys/pectin) of the systems with SP are slightly higher than those of BP at the same DM, and these values decrease sharply (50 times) with increasing DM. Tertiary and secondary structure of lys undergo a two-step change upon binding with increasing pectin/lys weight ratio (q) to that corresponding to maximal complexation q_{max}. Analysis of the thermodenaturation behavior of lys reveals that pectin has a higher affinity for the unfolded state than for the native state of lys. At $q \leq q_{max}$ (first stage of binding) the key factors stabilizing lys within its complexes with pectin against thermo-aggregation are a high local charge of pectin and, to a lesser degree, a low overall charge. At $q >> q_{max}$ (second stage of binding), a high local charge density of pectin is a key factor inhibiting thermo-aggregation of lys.



Photograph

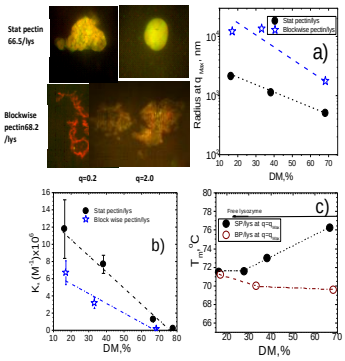


Figure 1. Confocal microscopy images of the SP66.5/lys and BP66.5/lys mixtures at different q values. a) Radius of complex particles as a function of DM, b) The binding constants as a function of DM, c) Unfolding temperature T_m of pectin/lys systems as a function of DM obtained from DSC data at q_{max}

Recent Publications

1. Antonov, Y.A., Moldenaers, P., & Cardinaels, R. (2017). Complexation of lysozyme with sodium caseinate and micellar casein in aqueous buffered solutions. *Food Hydrocolloids*,62: 102-118.
2. Antonov,Y.A., Zhuravleva, I.L., Volodine, A.,& Moldenaers, P. (2017). Effect of the Helix Coil Transition in Bovine Skin on Its Associative Phase Separation with Lysozyme. *Langmuir*. 33(47): 13530-13542.
3. Antonov, Y.A., Zhuravleva, I.L., Cardinaels, R., & Moldenaers, P. (2018). Macromolecular complexes of lysozyme with kappa carrageenan.Food Hydrocolloids 74: 227-238.
4. Antonov, Y.A., Zhuravleva, I.L. (2019) Complexation of lysozyme with lambda carrageenan: Complex characterization and protein stability. *Food Hydrocolloids*, 87: 519-529
5. Antonov, Y. A. Celus M., Kyomugasho. C., Hendrickx, M., Moldenaers, P., & Cardinaels. R.(2019). Complexation of pectins varying in overall charge with lysozyme in aqueous buffered solutions, *Food Hydrocolloids*, 94, 268-278.

Biography PhD, Dr (Chem) Yurij Antonov work in the field of Physical chemistry of biopolymers from 1972 year to present time. His study is focus on associative and segregative phase separation in biopolymer mixtures, structure of complex systems at rest and in a flow. At the present time he is principal scientist at the Moscow institute of Biochemical Physics RAS. He worked during last 19 years as a senior scientist and visiting professor at the Universities of Germany, France, Belgium, Portugal and Japan. E-mail: chehonter@yandex.ru