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The use of solid lipid nanoparticles to modify the properties and structure of β-lactoglobulin gels

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Abstract:
Nanoparticles show great potential as carriers of active substances enhancing the functionality of foods. Furthermore, they can modify food structure related properties such as firmness of gels. Their effect on these gel properties depends on the surface properties, size, shape and number of the particles, among others. Besides the impact of solid lipid nanoparticles (SLN) on protein gel properties, we investigated the change in SLN size after heating in the presence of β-lactoglobulin (BLG). The aim of this work was to understand how SLN influence gel formation and structure.
SLN were prepared by hot emulsification and stabilized by sucrose palmitate, lecithin and Tween 20 or BLG. SLN stabilized by BLG (B-SLN) or Tween 20 (T-SLN) were added to the BLG before heat denaturation at varying concentrations (0.25 to 2.5 %). Gelling of the protein was induced by decreasing the pH value. Samples were characterized before and after heat treatment regarding adsorbed protein and particle size distribution. The characterization of the gels included syneresis and mechanical properties.
T-SLN developed a BLG adlayer before the heat treatment. After the heat treatment, the T-SLN – BLG - dispersion had a bimodal shape containing larger and smaller particles than the initial SLN. This is interpreted as the presence of protein aggregates and large coalesced SLN. T-SLN did not affect the Young's modulus of the gels. Furthermore, in all gels containing T-SLN, particles were present in the syneresis water, i.e. washed out from the gel. B-SLN also showed a BLG adlayer before heat treatment. The particle size distribution of heated B-SLN-BLG dispersions was monomodal and B-SLN increased the Young's modulus of the gels compared to the control.
The results indicate the integration of B-SLN in the network and their function as bound particles. Although T-SLN showed a diffuse layer of surrounding BLG before the heat treatment, they did coalesce during the heat treatment and acted as unbound particles.
This study will help in better understanding the behavior of nanoparticles during gel network formation which is important if SLN are to be used as carriers of bioactive substances in complex food systems.

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