

Stability of emulsions containing sodium caseinate and dextran sulfate: Relationship to complexation in solution

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Abstract

The effect of addition of the anionic polysaccharide dextran sulfate (DS) on the properties of *n*-tetradecane-in-water emulsions containing sodium caseinate (CN) has been studied under different pH and ionic strength conditions. Two methods were used for preparation of the emulsions (20 vol% oil, 0.5 wt% CN, 0.1–1 wt% DS). In ‘bilayer emulsions’, the DS was added to a CN-stabilized emulsion after emulsification; in ‘mixed emulsions’, the oil was directly emulsified into the mixed biopolymer solution. At pH = 6, DS was found to adsorb onto CN-coated droplets, and extensive aggregation due to bridging flocculation occurred at 0.1 wt% DS. Polymeric stabilization was observed at higher polysaccharide concentration (1 wt% DS). In the mixed emulsions, no bridging flocculation was observed at any DS concentrations. These contrasting results for the two preparation methods indicate that strong interactions are present already at a pH value above the isoelectric point of the protein, and that the structure of the adsorbed layer at the oil–water interface is different for the two sets of systems. When the pH of emulsions containing 0.5 wt% DS or less was lowered towards acidic values, precipitation was observed. The mixed and bilayer emulsions containing 1 wt% DS were found to be more stable at pH = 2 than the emulsion without DS. Mixed emulsions containing 1 wt% DS exhibited good shelf-life stability on quiescent storage for 3 weeks, especially when the emulsion was prepared at low pH. Complexes were found to dissociate when 0.1 or 0.5 M NaCl was present, suggesting that associative interactions between CN and DS are mainly electrostatic.

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1. Introduction

Biopolymer interactions are widely used to improve the shelf-life and texture of food products. Many studies of the interactions between proteins and polysaccharides have been reported in solution (de Kruif & Tuinier, 2001; de Kruif, Weinbreck, & de Vries, 2004; Doublier, Garnier, Renard, & Sanchez, 2000; Schmitt, Sanchez, Desobry-Banon, & Hardy, 1998; Turgeon, Beaulieu, Schmitt, & Sanchez, 2003). The formation or dissociation of milk protein–polysaccharide complexes and their solubility depends on parameters such as the type of biopolymers involved and their concentration, the pH, ionic strength,

calcium ion concentration, the temperature, and the presence of anionic surfactants, e.g., sodium dodecyl sulfate (SDS) (Schmitt, Sanchez, Thomas, & Hardy, 1999; Weinbreck, de Vries, Schrooyen, & de Kruif, 2003; Weinbreck, Nieuwenhuijse, Robijn, & de Kruif, 2004; Ye, Flanagan, & Singh, 2006). Thus, when the pH is reduced below the protein’s isoelectric point and the net positive charge of the protein is increased, negatively charged polysaccharides can interact with the positively charged residues present on the protein and form complexes (Dickinson, 1998). An increase in ionic strength leads to screening of charges and weaker electrostatic interactions between the two biopolymers.

The presence of a polysaccharide in a protein-stabilized emulsion can have a great influence on the emulsion properties (Dickinson, 2003). Various studies have been

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