500d Thin Film Stability with a Viscoelastic Air-Liquid Interface

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The ability of proteins to provide stability in food foams is greatly influenced by their interfacial rheological properties. Linear stability analysis for a film on a solid surface with a viscoelastic air-liquid interface is presented. The interfacial dilatational and shear viscoelastic properties were described by Maxwell models. Dilatational and shear interfacial elasticity and viscosity were shown to improve film stability. When the interfacial rheological properties are extremely large or small, the maximum perturbation growth coefficient is shown to reduce to those for immobile and mobile interfaces respectively. Surface tension response of a pulsating bubble with adsorbed layer of beta-lactoglobulin was measured for different frequencies and protein concentrations using a pulsating bubble tensiometer. The proposed model was employed to infer the interfacial dilatational viscosity and elasticity of adsorbed beta-lactoglobulin layer at air-water interface from the experimental pulsating bubble data for protein concentrations in the range of 0.01 to 0.5 wt % at pH 7. As expected, the interfacial dilatational rheological properties were found to be higher at higher protein concentrations, this effect being less pronounced for dilatational elasticity. Surface shear elasticity and viscosity were measured for beta-lactoglobulin using Camtel Interfacial rheometer. The experimental dilatational and shear rheological parameters of the Maxwell model were employed to calculate the maximum growth coefficient for a thin film. Calculated values of maximum growth coefficient for thin film stabilized by 0.5% beta-lactoglobulin approached those of mobile films for thick (>2000 nm) and those for immobile films for thin (<100 nm) films respectively with the values lying between the two limits for intermediate film thicknesses.