Interfacial shear rheology of β-lactoglobulin fibers compared to the native proteins

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The interfacial shear rheology of β-lactoglobulin based systems, was investigated at different pH values in the range 2-5, at the water-oil interface, after 16.7 hours adsorption and aging. At pH 2, a major contribution of repulsive interactions to the structure and dynamics at the interface was found. The systems included native monomers and heat-induced β-lactoglobulin fibers (dialysed or not) of two different lengths. Results show that all systems build, after several hours, a dominantly elastic linear response in the frequency range 10⁻³ to 1 Hz, suggesting jammed interfaces. Comparisons at pH 2, show that the modulus was higher with more flexible fibers and with mixtures of rods and fibers. However, the long-time creep-compliance response suggested a very broad viscoelastic relaxation spectrum, with a contribution of relaxation times that could be longer than a day. The creep-compliance curves could be fitted by $J(t) = J_0 + bt^\alpha$, with the same $\alpha$ value and ratio $J_0/b$ for all systems, within the experimental window probed. A superposition on a single master-curve can be achieved just by using a single factor on their amplitude. This suggests a fundamental type of interaction leading to the observed similarity in the spectrum of relaxation times of the interfaces at pH2 for these aged β-lactoglobulin based interfaces. It seems that the superimposition does not hold anymore when the pH is varied.

In contrast, the non-linear behaviour showed more pronounced differences between systems at a given pH, whereby it was observed that in the presence of fibers, higher moduli were accompanied by higher fragility.