Protein stabilised foams; stability and rheological properties

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Many food products include a gas dispersed phase creating a foam structure. Some examples are cappuccinos, mousses and milk shakes. Foams are thermodynamically unstable systems, as they are prone to drainage, coalescence and disproportionation (similar to Ostwald ripening for emulsions) and generally have a lifetime of some orders of magnitude smaller than that of emulsions (hours compared to months) [1]. A common way of stabilising foams is by the use of proteins. The mechanism of foam formation and stability has been the focus of attention since the beginning of industrial processing of milk.
Trying to identify ways of producing foam structures that are more stable, there is a potential in altering the mechanical properties of the bulk phase and the interfacial films. This will create a viscoelastic continuous phase that will be more resistant to ripening, drainage and coalescence all together. This study aims to find the necessary techniques in order to study the effect of different formulations on the mechanical properties of the liquid films and strucutred foams. Therefore, insights on the elasticity of the film surface and the rheological properties of foams are studied together with the foaming properties.
In this study, the mechanism of foam stabilisation by proteins and their structures is being described focusing on the effect of protein concentration on the rheological and foaming properties of the interfacial films. Model systems containing whey protein isolate (WPI) at 4 different concentrations (1%, 3%, 5% and 10%) were studied. The stability of protein foams was investigated using the traditional method[2] where foam is produced and the density and volume is recorded over time. The effect of the concentration of protein on the bulk rheological properties is demonstrated in terms of elastic (G') and viscous (G'') modulus and apparent viscosity (η_{α}) (Figure 1).

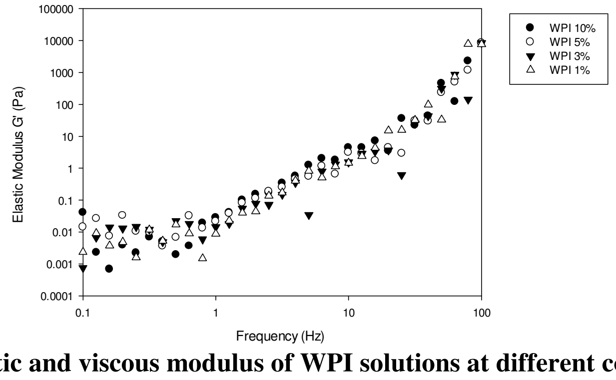

Figure 1 Elastic and viscous modulus of WPI solutions at different concentrations.

The rheological properties of the foams[3] were also measured in terms of G' and G'' by using dynamic oscillatory techniques (Figure 1). An investigation on the rheological properties of the film formed at the air/water interface by the use of interfacial shear rheology with a Du Noüy ring attached to a rheometer is also shown and discussed (Figure 2). Finally, an overview of the associations between the bulk and interfacial mechanical properties of the suspensions and their foams and the stability of the foams is illustrated and explained.

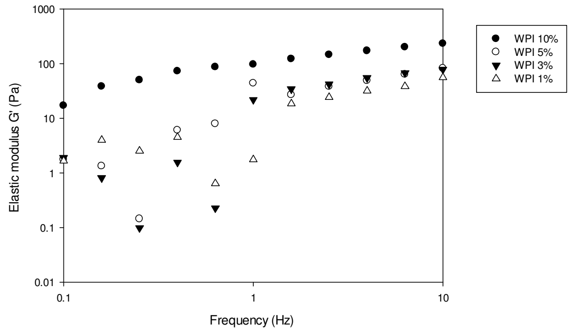

Figure 2 Elastic modulus of foams prepared with WPI at different concentrations after applying oscillatory stress.

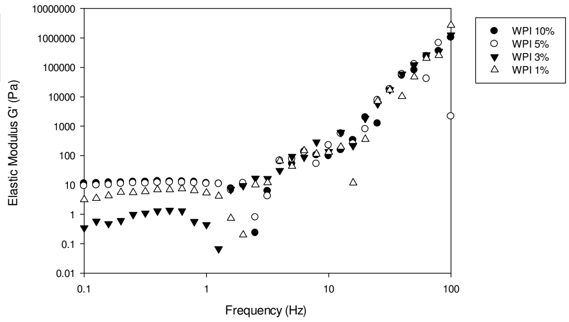

Figure 3 Elastic modulus of the film at the air water interfaces prepared with WPI at different concentrations.

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