



**HAL**  
open science

## Vers un contrôle des propriétés macroscopiques des milieux dispersés par les propriétés associatives des protéines alimentaires

Stephane Pezenec, Cécile Le Floch-Fouéré, Said Bouhallab, Yann Desfougeres, Valérie Lechevalier-Datin, Thomas Croguennec, Anne Renault, Arnaud Saint-Jalmes, Françoise Nau, Gilles Paboeuf, et al.

### ► To cite this version:

Stephane Pezenec, Cécile Le Floch-Fouéré, Said Bouhallab, Yann Desfougeres, Valérie Lechevalier-Datin, et al.. Vers un contrôle des propriétés macroscopiques des milieux dispersés par les propriétés associatives des protéines alimentaires. *Polymerix* 2012, 5. Colloque Européen : Diversité et perspectives d'applications industrielles des biopolymères, May 2012, Rennes, France. hal-01209700

**HAL Id: hal-01209700**

**<https://hal.science/hal-01209700v1>**

Submitted on 3 Jun 2020

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

***Vers un contrôle des propriétés macroscopiques des milieux dispersés  
par les propriétés associatives des protéines alimentaires***

***Striking associative properties of food proteins: a switch to control bulk  
properties of dispersed media***

**S. Beaufils, S. Bouhallab, F. Nau, V. Lechevalier, C. Le Floch-Fouéré, S. Pezennec**

Institut de Physique de Rennes, UMR-CNRS 6251, 263 avenue du Général Leclerc, Campus de  
Beaulieu, 35042 Rennes cedex

UMR1253, INRA, Agrocampus-Ouest, Science et Technologie du Lait et de l'œuf, 35042 Rennes  
cedex

Many food proteins as egg white or milk protein show tensioactive properties. This means that one region of the protein has affinity for polar environment and another region of the protein prefers an apolar environment. For that reason, these proteins tend to adsorb to amphiphilic-hydrophobic interfaces such as air-water interface of bubble surface in case of foams or oil-water interface of droplets surfaces in case of emulsions. In both cases, food proteins act as stabilizers of the dispersed medium. In addition, and in contrast with small-molecular weight surfactants, proteins can also self-associate and form an interfacial film with viscoelastic properties, which also contributes to stabilization.

However, their tensioactive properties confer to food proteins striking associative properties that this presentation will illustrate following three ideas:

The mixture of two proteins as components of a dispersed medium can lead to enhanced bulk properties compared to the case where each protein is alone, even if one protein is in very small amount in the mixture. **This property offers the possibility to modulate bulk properties of a mixture using one protein as an additive.** The case of foaming properties of ovalbumine-lysozyme will illustrate this idea. We have shown (1,2) that the interaction between proteins preferentially takes place at the air-water interface and that the interfacial adsorbed film is stratified, the most tensioactive protein being adsorbed first.

The association of two proteins can lead to the formation of monodisperse microspheres, the ratio of each protein in the microsphere depending on the charge ratio. This property is illustrated by the case of the mixture alpha-lactalbumine/lysozyme (3). **We have shown that the first steps of these bulk associative properties are revealed by the interfacial properties of these proteins.**

The last part of this presentation shows how very slight modifications of a protein, hardly detectable with standard bulk characterisation tools, can lead to drastic changes in foaming and interfacial properties. The case of dry-heated lysozyme will be exposed, for which we have

shown (4) that a modification of one unique aminoacid greatly affects the interfacial properties of the protein and consequently greatly enhance the bulk properties of the foam. **It evidences that small changes on a protein can act as a swich relative to the bulk properties of the dispersed media stabilized with this protein.**

- (1) C. Le Floch-Fouéré S. Pezennec , V. Lechevalier , S. Beauflis , B. Desbat , M. Pézolet ' F. Nau and A. Renault Synergy between ovalbumin and lysozyme leads to non-additive interfacial and foaming properties of mixtures *Food Hydrocolloids* (2009) 23 352-365
- (2) Le Floch-Fouéré C., Beauflis, S., Lechevalier V., Nau, F., Pezolet M., Renault A., Pezennec S. Sequential adsorption of egg-white proteins at the air-water interface suggests a stratified organization of the interfacial film *Food Hydrocolloids* (2010) 24 275-284
- (3) M. Nigen, T. Croguennec, D. Renard, S. Bouhallab. Temperature Affects the Supramolecular Structures Resulting from  $\alpha$ -Lactalbumin-Lysozyme Interaction. *Biochemistry* (2007), 46, 1248-1255
- (4) Y.Desfougères, A. Saint-Jalmes, A. Salonen, V.Vié, S. Beauflis, S. Pezennec, B. Desbat, V. Lechevalier, F. Nau. Strong Improvement of Interfacial Properties Can Result from Slight Structural Modifications of Proteins: The Case of Native and Dry-Heated Lysozyme *Langmuir* (2011) 27, 14947-14957