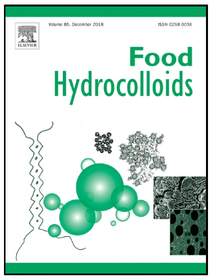
Accepted Manuscript



Multi-scale understanding of the effects of the solvent and process on whey protein emulsifying properties: Application to dairy emulsion

Marine Moussier, Véronique Bosc, Camille Michon, Violaine Pistre, Cyril Chaudemanche, Delphine Huc-Mathis

PII: S0268-005X(18)31132-9

DOI: 10.1016/j.foodhyd.2018.08.052

Reference: FOOHYD 4633

To appear in: *Food Hydrocolloids*

Received Date: 21 June 2018

Accepted Date: 30 August 2018

Multi-scale understanding of the effects of the solvent and process on whey protein emulsifying properties: Application to dairy emulsion

Marine Moussier[a], Véronique Bosc[a], Camille Michon[a], Violaine Pistre[b], Cyril Chaudemanche[b], Delphine Huc-Mathis[a]

[a]Ingénierie Procédés Aliments, Inra, AgroParisTech, Université Paris-Saclay, 91300 Massy, France
[b]Vienne Technical Center, Yoplait/General Mills, Chemin des Mines, 38200 Vienne, France

Abstract

The combined effects of solvent and processing on whey protein isolate (WPI) emulsifying properties were investigated using a multi-scale approach in realistic conditions. WPI was solubilized in purified water or permeate then no treated, heat treated, mechanically treated (rotor/stator-sonication) or treated by dynamic pressure (16, 100, 350 MPa). Afterward, the treated WPI solutions were used to make emulsions. The approach revealed links between physico-chemical and interfacial properties of the WPI, and the final structure of the resulting emulsions. As expected, the heat treatment caused great changes, with the aggregation of the proteins and the increase in the exposure of hydrophobic zones of the aggregates. The high dynamic pressure of 350 MPa also led to changes in physico-chemical properties, but the mechanical treatment only caused few changes. The adsorption kinetics and reorganization of WPI at the interface depended on their aggregation state, hydrophobicity, ζ-potential and total free SH. All the non-aggregated WPI adsorbed as a thick film at the oil/water interface except the ones treated at 350 MPa, which adsorbed as a thinner film. The sample treated at 100 MPa might have the most close-packed interfacial film, with the highest amount of protein loaded. When aggregated, the whey proteins needed more time to adsorb at the interface and few reorganized once adsorbed. The final interfacial elasticity was higher in water than in permeate. Depending on the solvent, heating and pressure, the variety of physico-chemical properties obtained resulted in different emulsion structures: stable, more or less aggregated or slightly coalesced. A diagram based on the solvent and processing effects was proposed to link organizations at the three studied scales.

Keywords

Physico-chemical properties, heat treatment, high pressure, structure, interfacial properties, rheology.

1. Introduction

Whey proteins isolates (WPI) are obtained from dairy co-products through well optimized chains of a sustainable manufacturing. There are widely used in bakery, beverage and dairy industries because they are versatile ingredient with interesting nutritional, gelling, foaming and emulsifying properties (Ramos et al., 2016). In particular, they can be used as an innovative texture ingredient or fat replacer (Smithers, 2015). The term 'whey proteins' (WP) covers all soluble milk proteins, the main ones being β-lactoglobulin (β-LG) (≈ 50 %), α-lactalbumin (α-LA) (≈ 25 %), bovine serum albumin (≈ 10 %), immunoglobulin (≈ 10 %) and lactoferrin (≈ 5 %). When native, they are 5 nm globular proteins with an average isoelectric point around 5 (Singh, Boland, & Thompson, 2014). The β-LG conformation and its denaturation upon physical or chemical