Design of an innovative technological route using fractal whey protein aggregates instead of texturising agents to create clean label dairy products

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CONTEXT & AIM

- ✓ **In France, consumers and public authorities increasingly request healthy and safe products with as few ingredients as possible [National Program on Nutrition and Health-PNNS 4 and Loss leader pricing law (EGALIM3)].**
- ✓ **.**

CLEAN LABEL

Ingrédients
Lait entier, sucre, **crème** fraîche, amidon transformé de maïs, fructose, arôme, gélifiant : carraghénanes, colorant : rocou, protéines de **lait**, **lactose**.

- ✓ **The main aim of this work was to study how to replace the texturising agents usually used in dairy products (modified starches, carrageenans, etc.) with whey protein assemblies.**
- ✓ **Products must meet consumer's expectations including the use of processes that are simple and sustainable.**

STRATEGY:

plateforme LAIT STLO

The strategy of this project consisted in

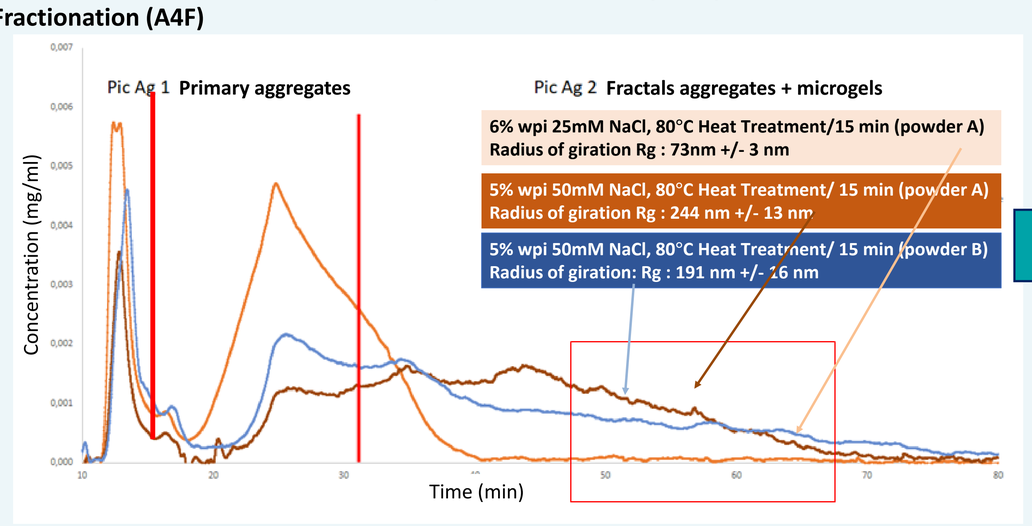
1. **Identify protein aggregates exhibiting good texturing properties for cream dessert at bench scale (fractals, microgels, fibrils, mixed) ,**
2. **Determine the best homogenization treatment to size the diameter of the fat globules to the dimensions of the selected aggregates (around 200 nm) to connect the fat globules to the protein assemblies and thus texturize the cream dessert,**
3. **Develop the simplest, most sustainable technological process possible, first on a bench scale and then on a pilot scale,**
4. **Test the consumer acceptability of the new dessert cream by a hedonic test.**

Throughout the project, biochemical and rheological analyses enabled us to characterize the products, in particular to compare them with market products.

Some of the results of this work build on findings of **PROFIL** (Functionalized Proteins for Dairy Industry) 2014 - 2018 project, in particular those obtained by **T. Loiseleux** (PhD thesis, Nantes University): Interfacial competition between soluble and aggregated proteins: droplet connectivity and texture of dairy emulsions

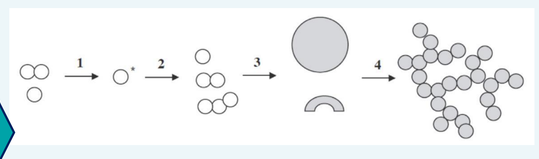
Milk Valley PROFIL

1. Determine the process for obtaining the selected protein aggregates with a size of around 200 nm in diameter from 2 WPI powders: A and B by: Assymetric Flow Field-Flow Fractionation (A4F)



RESULTS

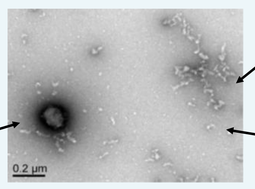
1. The selected protein aggregates were obtained by: 5% Whey protein Isolate (WPI), 25 mM NaCl, pH 7.0, heat treatment: 80°C/15 min, intermediate flow regime: 3500 Reynolds (Re),



β-LG aggregation process for pH 7

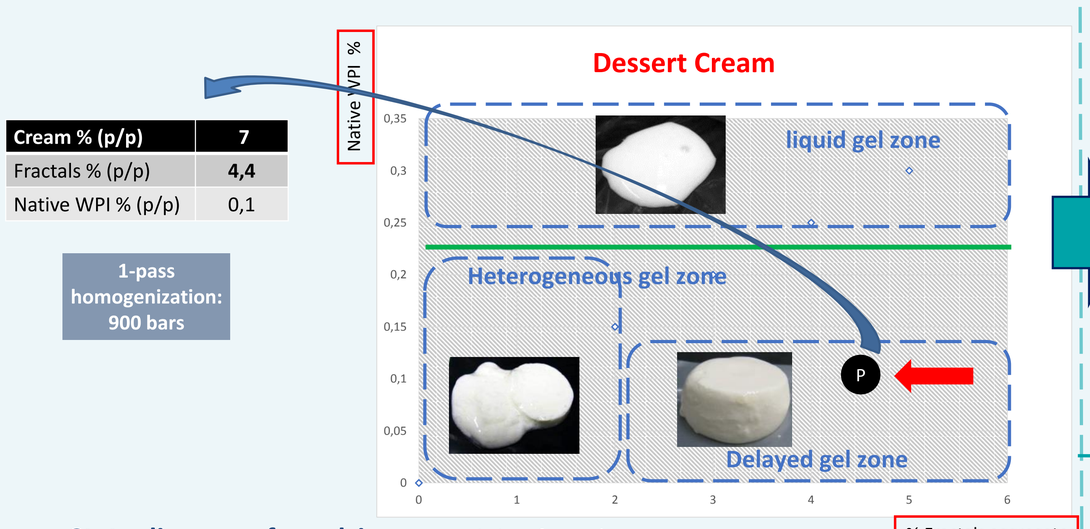
WPI solution before and after heat treatment

Selected protein aggregates composed of fractal aggregates and a small proportion of microgels



Transmission Electronic Microscopy (MET)

2. Determine the best homogenization scale to obtain droplet diameters of the same order of magnitude as the diameters of the assemblies.

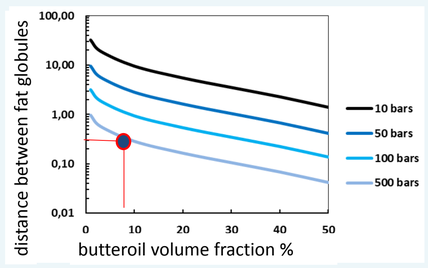


Cream % (p/p)	7
Fractals % (p/p)	4,4
Native WPI % (p/p)	0,1

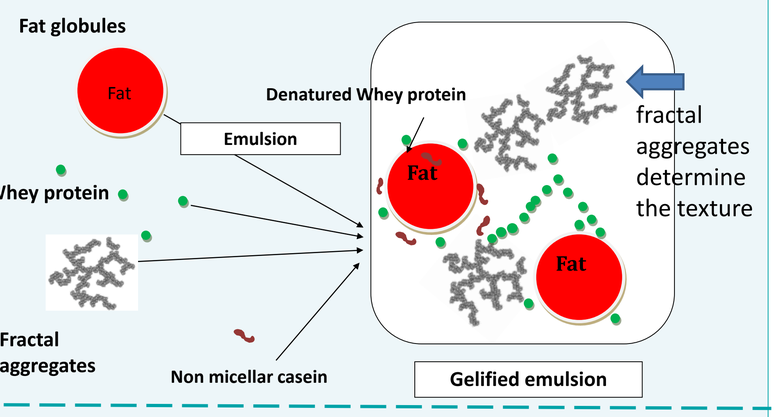
1-pass homogenization: 900 bars

State diagram of emulsions containing fractal aggregates, produced at **900 bar** with **7% MGLA** and stored at **4°C**.

2. The optimum homogenizing pressure achieved in a single pass is at least 700 bar for a 7% FM cream.



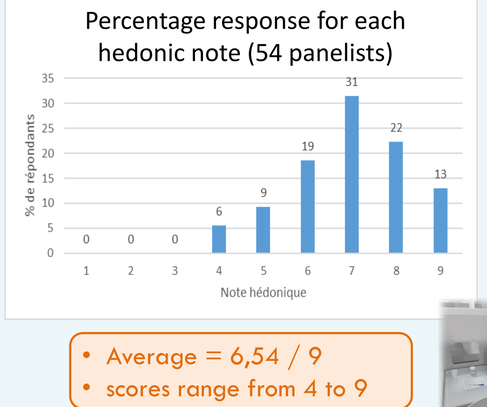
Modeling the effect of Butter oil volume fraction and homogenization pressure on the distance between droplets



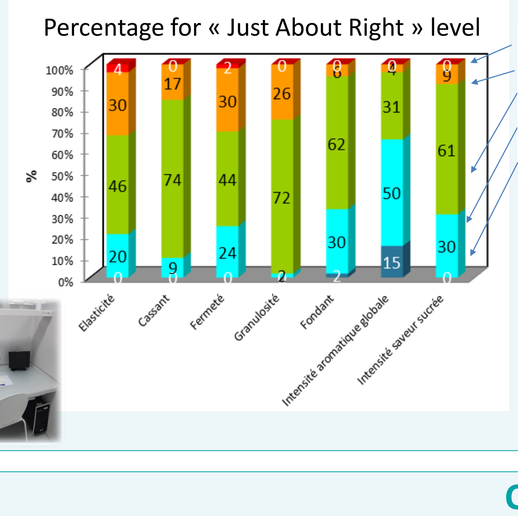
Modeling the effect of homogenization and fat volume on the distance between fat droplets and gel texturing: 7% Fat matter, 4,4% aggregates, 0,1% native WPI and a 700 bar single pass to obtain **the best structure**

3. Transfer the process from bench (~ 2kg) to pilot scale (~ 100 Kg) in a continuous process

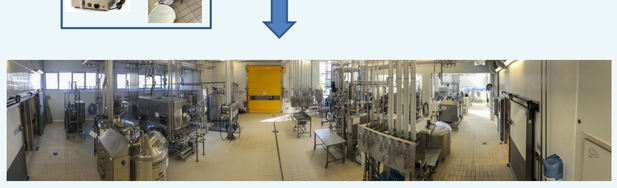
4. Consumer's acceptability



- Average = 6,54 / 9
- scores range from 4 to 9



3. The optimized technological parameters of the route are as follows

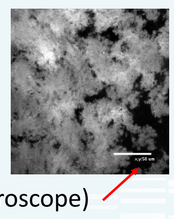


Dessert Cream with Proteins aggregates

- Raw materials
- Mix solubilisation — 50°C- 1H
- Homogenization — 60°C - 700 bars
- Continious Heat Treatment — 80°C - 1 min
- Cooling and storage — 4°C

- Proteins agregate: 4,4 %
- Native WPI: 0,1%
- Fat: 7%
- Sugar : 10 %
- Vanilia : 1%

4. The final product has a soft, pleasant texture and a viscosity comparable to that of commercial products at 4°C and 1 s^{-1} (DHR2 rheometer crosshatched plate-form geometry).



Confocal microscopy (Objective x 60 Nikon microscope)

The final product!

CONCLUSION & PERSPECTIVES

- ✓ Fractal aggregates have a high functional potential: **they can replace texturizing agents under certain conditions**.
- ✓ They should not be thought of as additives or technological aids, but rather **at the heart of the process**.
- ✓ Their use in **dairy**, **mixed** and **vegetable products** is yet **to be designed**.
- ✓ Production of a **knowledge e-book** for the project's academic and industrial partners

PROFIL knowledge book home page

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