Today, consumers seek for more healthy and natural products (without additives).

Objective
Stabilized whey protein-emulsions to heat treatment without using additives.

Context
Quality of dairy Emulsions
- Physical stability
- Microbial stability
- Non-Dairy additives
- Heat treatment

State of the art
- Industrial whey protein ingredients (WP/Cas) contain:
  - Whey proteins
  - And also some caseins, peptides,…
- Whey protein aggregation before emulsification improve emulsion stability. [2]

Whey proteins
- Natural emulsifiers but heat sensitive
- Stable
- Gelation

Caseins
- Caseins and whey proteins are in competition for adsorption at fat droplet surface
- Caseins preferentially adsorb at fat droplet surface due to their high surface activity
- Casein-stabilized emulsions are heat stable

Emulsion formation and analysis
Industrial whey protein ingredient
Heat treatment
Solutions of aggregated WP and Cas (70%) 3 % to 6 % proteins
Aggregated WP
Free Cas
Emulsification
Aggregated WP/Cas-emulsions
Heat treatment (1 to 30 min at 120°C)
Emulsion stability

Results
Before heat treatment : Caseins adsorb preferentially to aggregated whey proteins at fat droplet surface

Whey proteins at fat droplet surface
Aggregated WP in the aqueous phase
Fat droplet
Casein
Aggregates of whey proteins
Protein quantification and surface composition

Quantity of whey proteins at fat droplet surface ↘ with protein concentration
Quantity of caseins at fat droplet surface is constant

After heat treatment : Gelation of aggregated whey proteins governed emulsion stability at high protein concentration.

Coalescence Oiling off
- Caseins protect fat droplet against heat destabilization
- Not enough aggregates in the aqueous phase to form a gel
- There are enough aggregates in the aqueous phase to form a gel

Emulsion analysis
- stability
- structure

Heat treated emulsion with protein concentration.

Heat stability (minutes)
- Stable
- Gelation
- Oiling off

Pay attention to:
At low protein concentration (<3.5%), aggregated WP/Cas emulsions are less heat-stable than WP/Cas emulsions (Coalescence, oiling off)
At high protein concentration (>26%), aggregated WP/Cas emulsions are more heat-stable than WP/Cas emulsions.

Conclusion
Heat induced protein aggregation in industrial whey protein ingredients containing trace of caseins improves the heat stability of the prepared emulsions at high concentration.

- Caseins adsorb preferentially to aggregated whey proteins at fat droplet surface: Caseins mainly cover the fat droplet surface.
- Aggregated whey proteins have a high critical concentration of gelation in aqueous phase.

References

(1) STLO, Agrocampus Ouest, INRA, 35000, Rennes, France.
(2) BIA, INRA, 44316, Nantes, France.

www6.rennes.inra.fr/stlo