Les protéines solubles du lait pour texturer les aliments

Marie-Hélène Famelart, Elise Schong, Thomas Sevrin, Thomas Croguennec

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Interactions - Structures - Fonction des protéines

Context

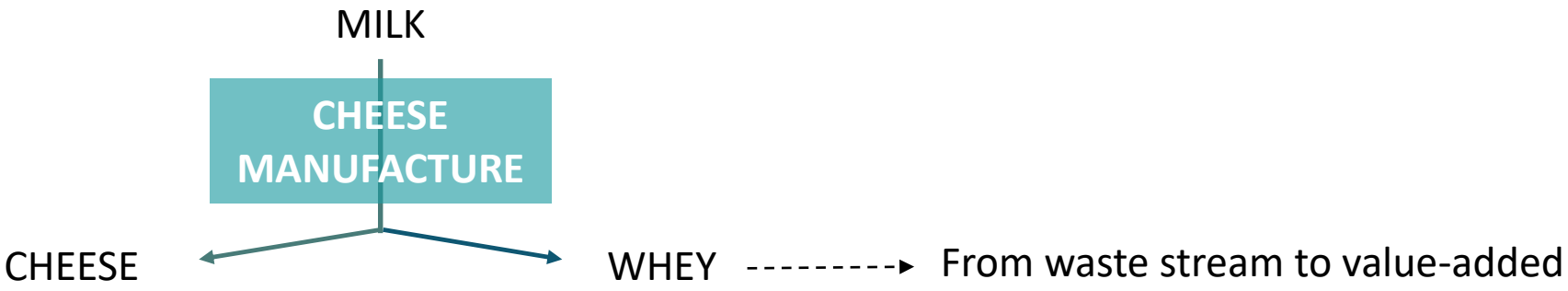
- Additives are currently used to control dairy product quality (texture, heat stability, phase separation,…)
- New trends in Europe driven by consumer's expectations

- Milk proteins are customizable into different assemblies that exhibit different properties than native proteins (water holding capacity, heat stability,…) → could be used to replace partly or totality food additives in dairy products

Milk Valley
PROFIL

Context

Whey proteins : Large amount available around the world



- 10% of the milk volume
- >80% of the milk proteins (caseins)

- 90% of the milk volume
- <20% of the milk proteins (whey proteins)

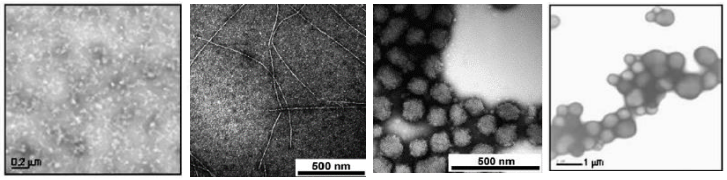
- Exceptional biological value (amino acid composition),
- Ligand carriers (vitamins, minerals, fatty acids)
- Bioactive proteins and peptides

Excellent for human nutrition

Introduction: whey proteins as texturizing ingredients

Whey proteins:

- Heat-induced aggregates produced by heating treatments in solution for increased functional properties



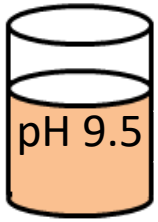
- Dry heating or heating a protein powder: process used for white egg powders for increasing foaming, emulsifying and gelling properties (Kato et al. 1989),
- Dry heating of dairy powders: less studied and not used
- Dry heating: a way to produce other changes of whey proteins
  - ✓ Limited diffusion of solutes = less aggregation
  - ✓ Traces or addition of lactose, degradation products of Maillard intermediates such as dicarbonyl
    ⇒ crosslinks

Research Questions

- **How to custom protein assemblies with targeted sizes?**
- **How to custom their functional properties such as their ability to entrap large amounts of water and deliver high viscosities?**

to replace food texturizing additives

How to custom protein assemblies with targeted sizes?



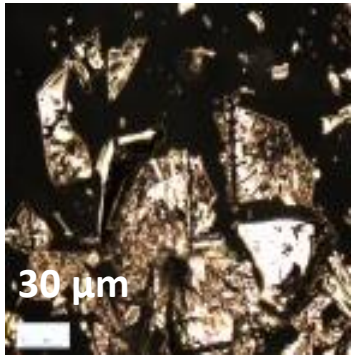
Whey proteins

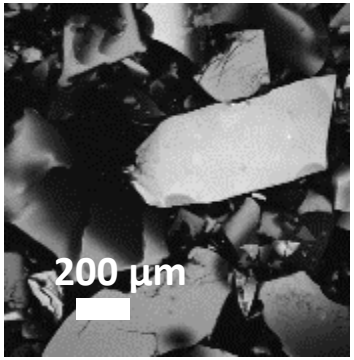
Drying

Dry heating

Suspension

Powder

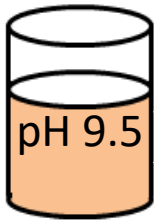




Dry-heated powder in suspension

Pulvérisation

How to custom protein assemblies with targeted sizes?



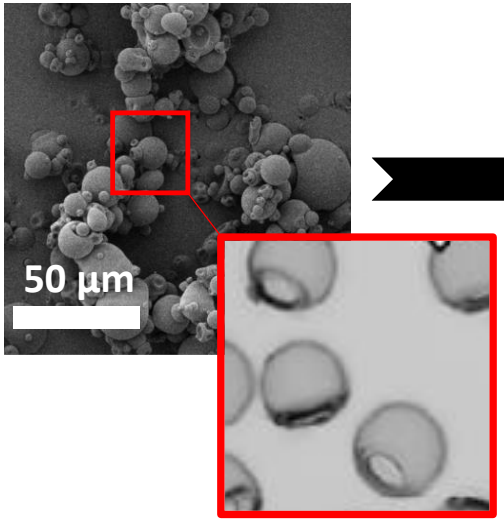
Whey proteins

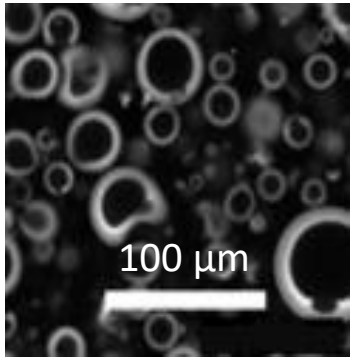
Drying

Dry heating

Suspension

Powder



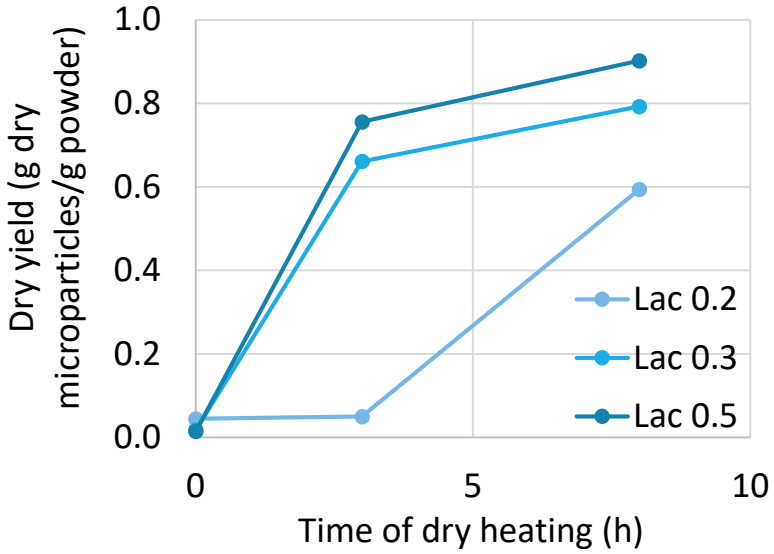


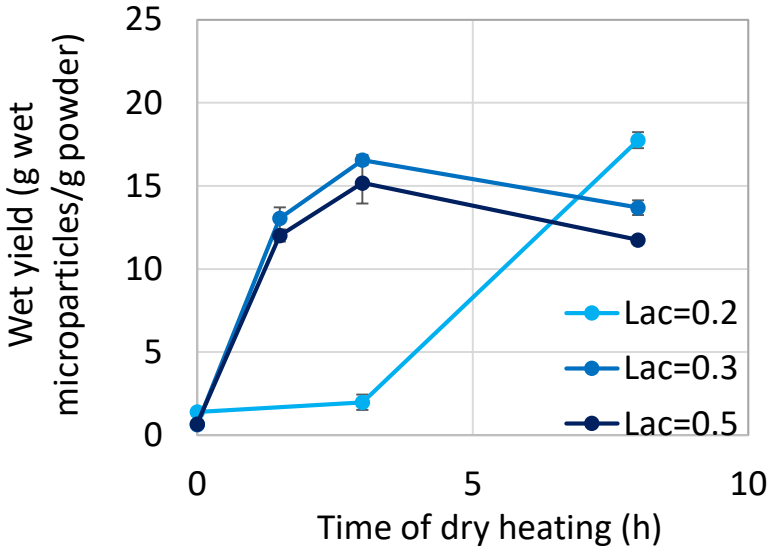
Dry-heated powder in suspension [10-100 µm]

- Dry heating ⇒ powder no longer soluble
- Crosslinks between proteins
- Microparticles have a size and shape related to the size of the powder before dry heating

How to custom their functional properties such as their ability to entrap large amounts of water and deliver high viscosities?

Yield of transfer of whey proteins into microparticles



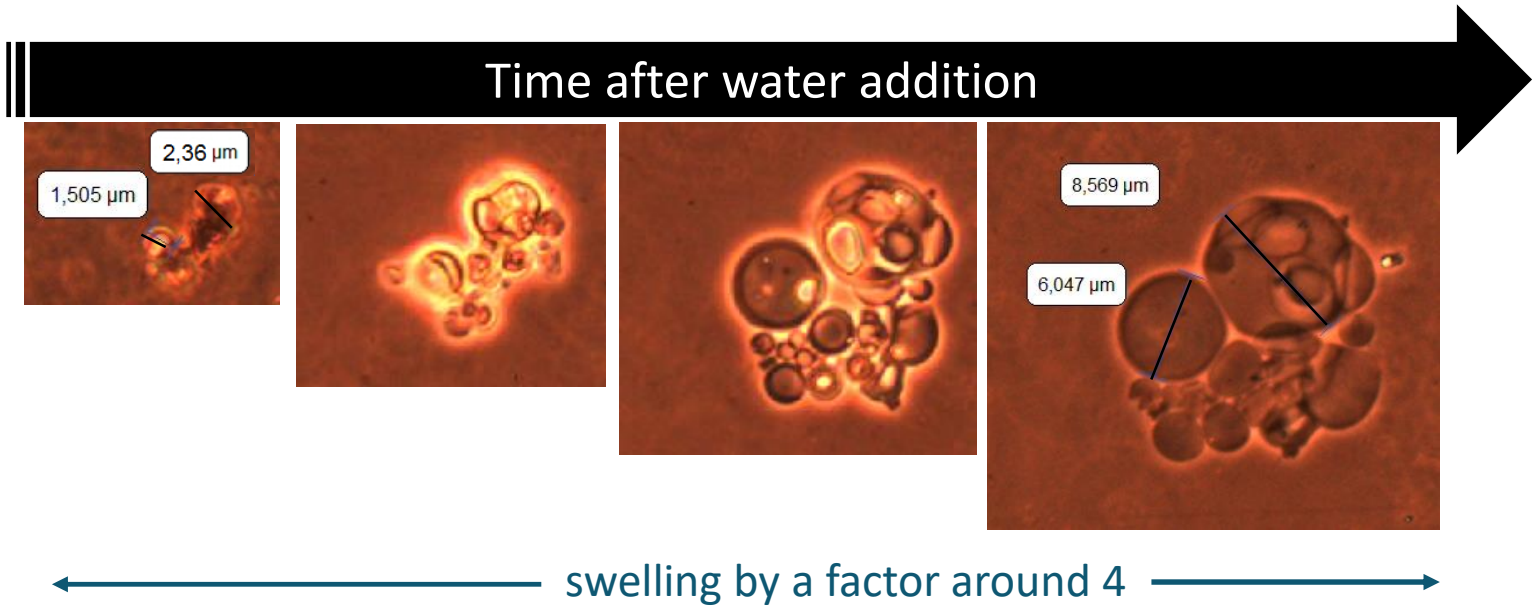


- 1 g of powder → 0.9 g of microparticles → 15 g of wet particles
- 95% weight of microparticles = H_2O
- Due to the porous structure of powders

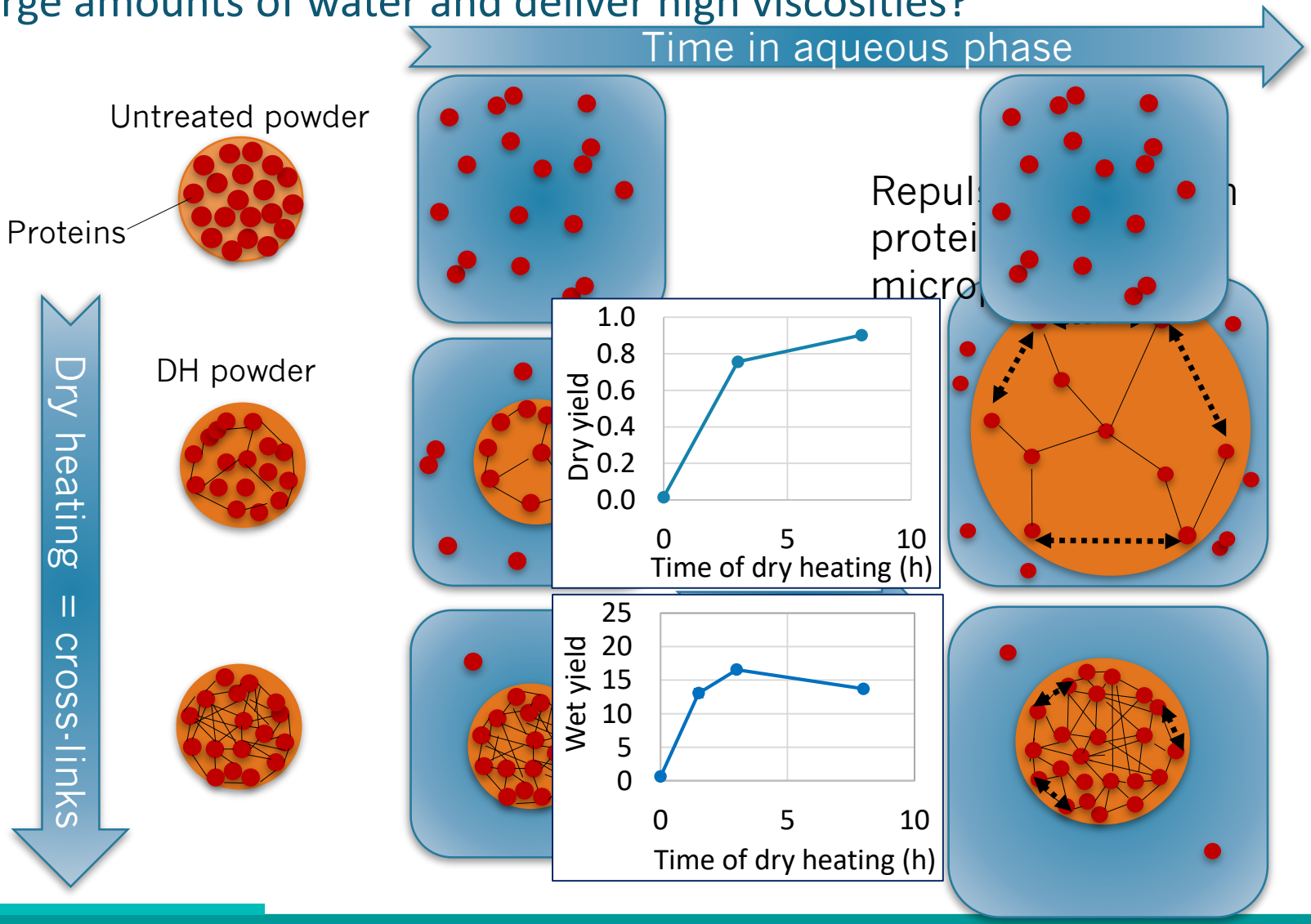
How to custom their functional properties such as their ability to entrap large amounts of water and deliver high viscosities?

1- Due to porous structure of powders ⇒ Microparticles entrap a large amount of water

2- Ability of microparticles to swell in the water

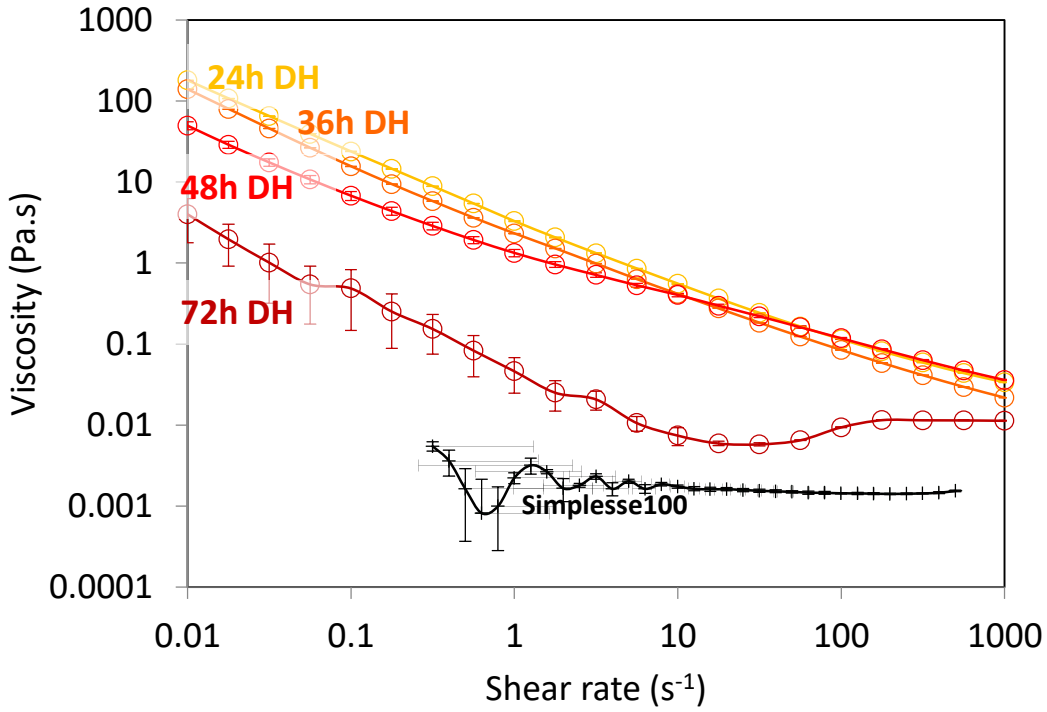


How to custom their functional properties such as their ability to entrap large amounts of water and deliver high viscosities?



How to custom their functional properties such as their ability to entrap large amounts of water and deliver high viscosities?

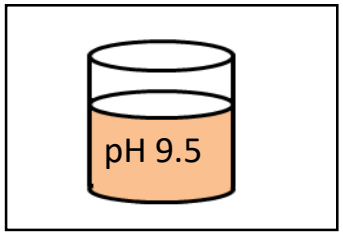
Spray dried powder: 23 g macroparticles/kg suspension



- Very high viscosity as compared to micro-particulated whey proteins (d[4,3]~10 µm)
- Viscosity decreases with increased dry heating duration
  - ✓ reduced d[4,3]
  - ✓ reduced water content

Conclusions

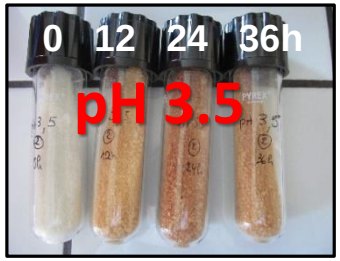
Mechanism of formation and nature of the protein crosslinks still speculative

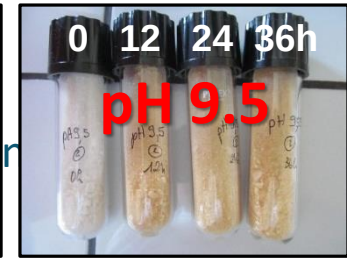


2 phases

- Alkaline pH values only required during the liquid state
- We can form microparticles only at pH > 8.0 (but Maillard reaction at pH <8.0)
- Time of storage at alkaline pH values ↑ ⇒ amount of microparticles ↑
- Role of alkaline pH values?
  - ✓ very few denaturation
  - ✓ significant aggregation of whey proteins
  - ✓ Increased exposure of lysine residues?

- Lactose only required during the dry state
- Role of lactose?
  - ✓ degradation via Maillard reactions?
  - ✓ degradation products of lactose at high temperature?





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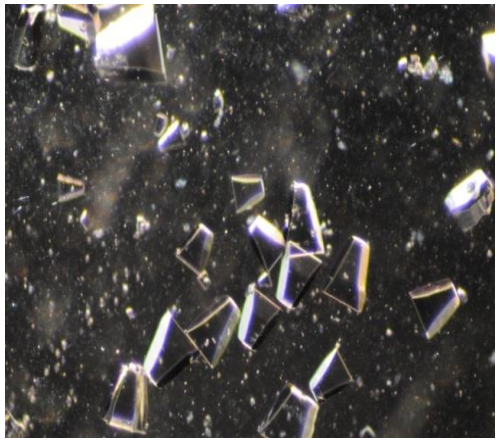

THANK YOU FOR YOUR ATTENTION

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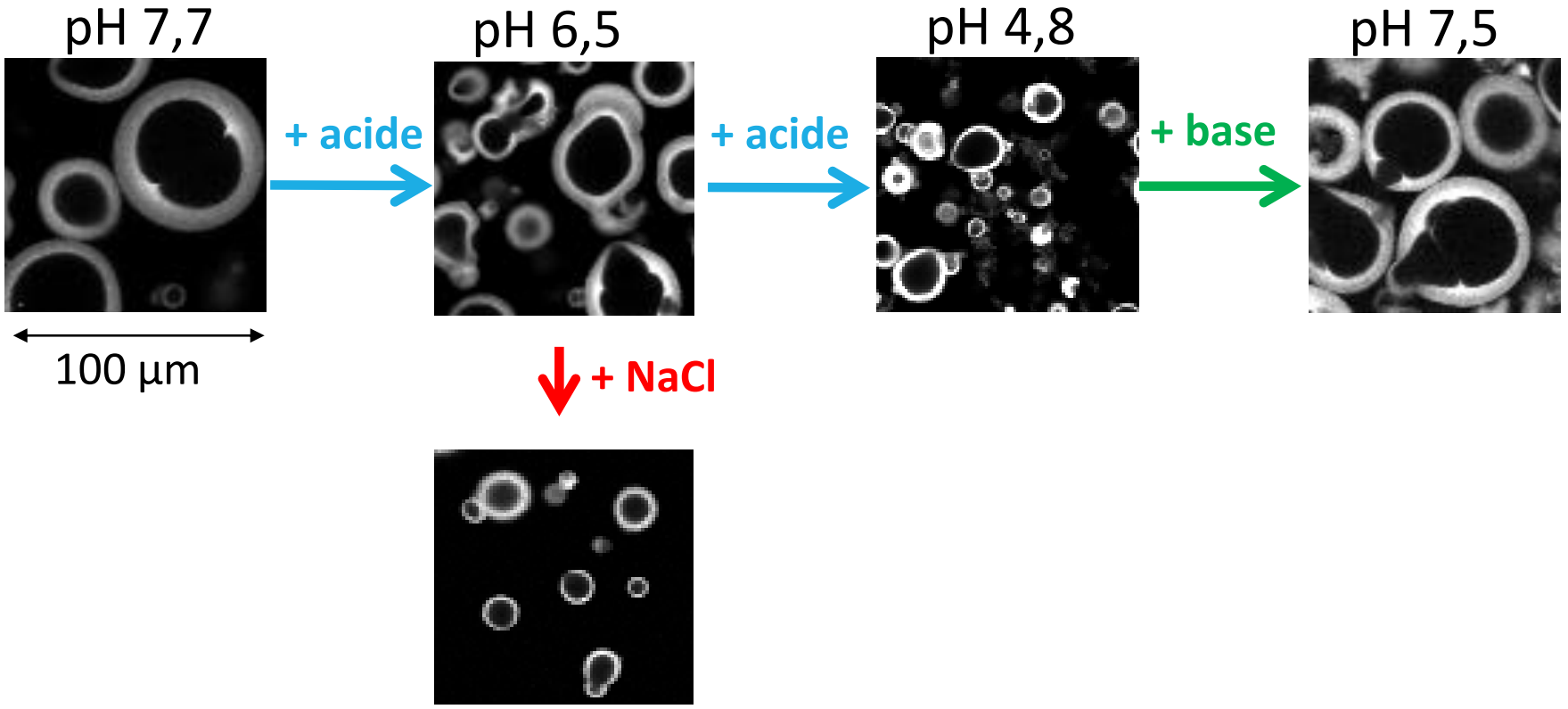
Propriétés remarquables des AMI



Les AMI se comportent comme une éponge : ils peuvent gonfler et dégonfler selon leur environnement