Impact of mechanical treatment and particle concentration on fruit suspensions stability

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UMR Ingénierie Procédés Aliments ***(JRU Food & Process Engineering)***

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The objective of this work is to confirm the **structural parameters** that **control the rheological behaviour of plant cells dispersions** related to the texture of the products and to **pave the way for stabilization methods of fruit suspensions limiting the use of additives**.

Two species presenting different cellular structure were studied as examples:

- **apple** (*Malus domestica Borkh. cv* Golden Delicious)
- **acai** (*Euterpe oleracea Mart.*)

Research question:

How to stabilize fruit suspensions limiting the use of additives ?

Material and Methods

MATERIAL

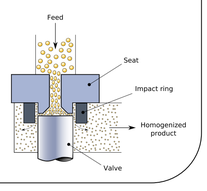
Apple puree →  **Grinding** (3 levels) →  **Separation** (5000g, 2H, 20°C) →  **Reconstruction** (Mixing from 0 to 2.32 g/100g)

Acai juice
Water, acai pulp, cane syrup, lemon juice

→  **Colloidal Mill**
10 000 rpm, 1min

→ No additionnal treatment

→ **HPH**
200-400 MPa



STRUCTURE

Particle size distribution
Mastersizer 2000, Malvern

Settling stability
Turbiscan^{TM} LAB, Formulaction

Light microscopy
Olympus BX51

BEHAVIOUR

Rheology
MCR 301, Anton Paar, using large gap coaxial cylinders (δr=5mm)

Steady-state measurements
Flow curve from 10 to 250 s-1

Oscillatory measurements
Frequency and strain sweeps

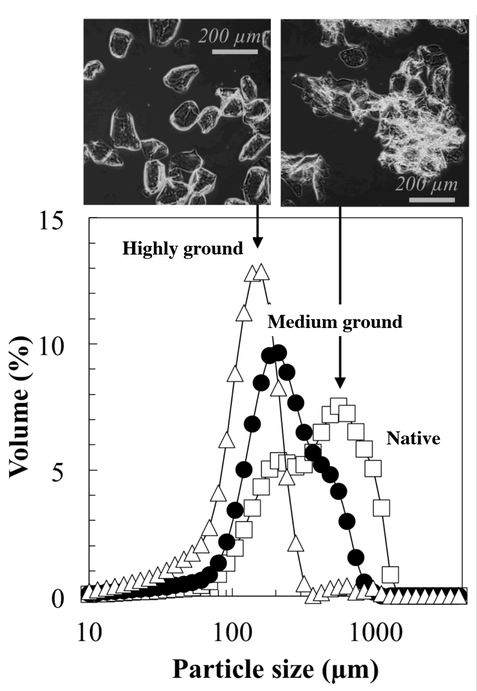
Results

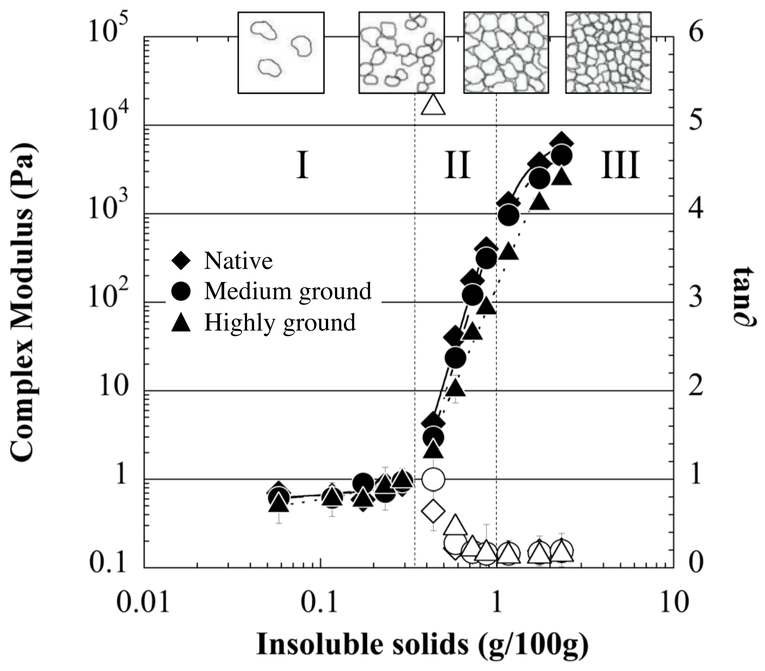
Apple Suspensions

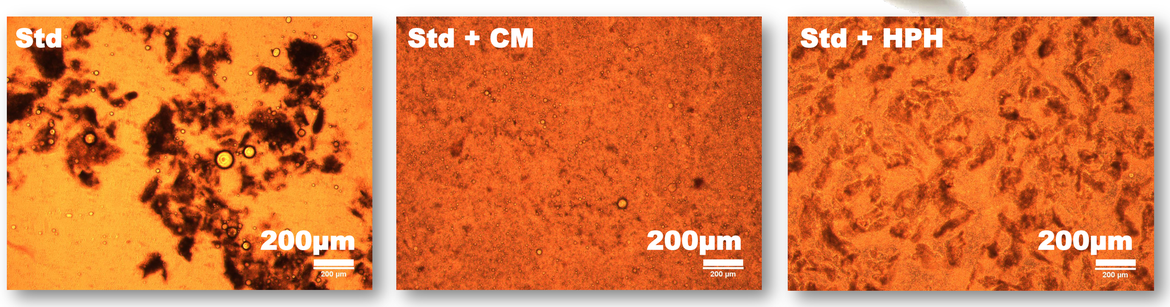
The insoluble solids content allows to structure to medium. Three concentration domains are highlighted. The appearance of a weak network is observed whatever the particle size distribution.

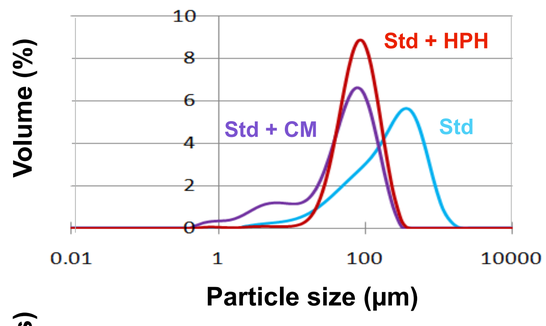
Acai Juices

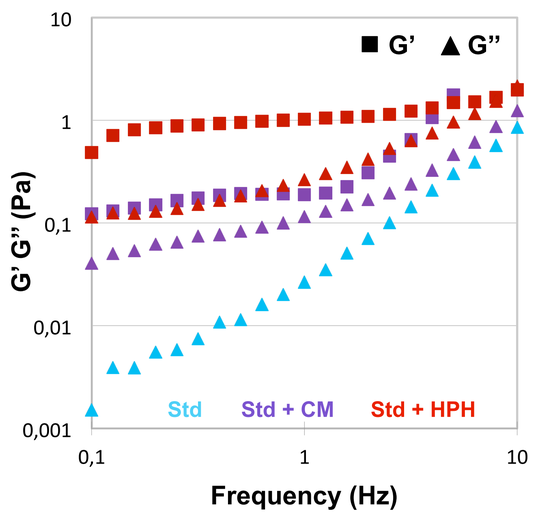
Mechanical treatments allow to functionalize the disperse phase and to create a weak gel, avoiding sedimentation and creaming.

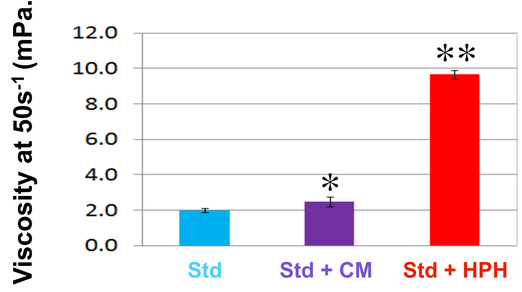












Conclusions

For apple, three concentration domains were observed depending on the concentration of insoluble solids

- ✓ **Diluted domain :** Particles size and shape have a little effect on rheology
- ✓ **Semi-diluted domain :** Building of a weak network between the particles
- ✓ **Concentrated domain :** Particles begin to pack

These results suggest that a very small amount of particle allows structuring the medium by creating a weak gel, which was confirmed by the results obtained on acai.

Stabilization of acai juices was successfully achieved using physical treatments, which decreased the particle size and helped building a connected network. These effects are all positive levers on stabilization, as can be seen after 5 months of storage.

Particle size and shape have a major impact on rheological behavior and stability of fruit suspensions.

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