Thickened waters: sensory perception of texture correlated with rheological and chemical characterizations

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Chaire « Aliments et bien-manger » - Fondation Rennes 1

Jean-Claude MOSCHETTI

Ingredients

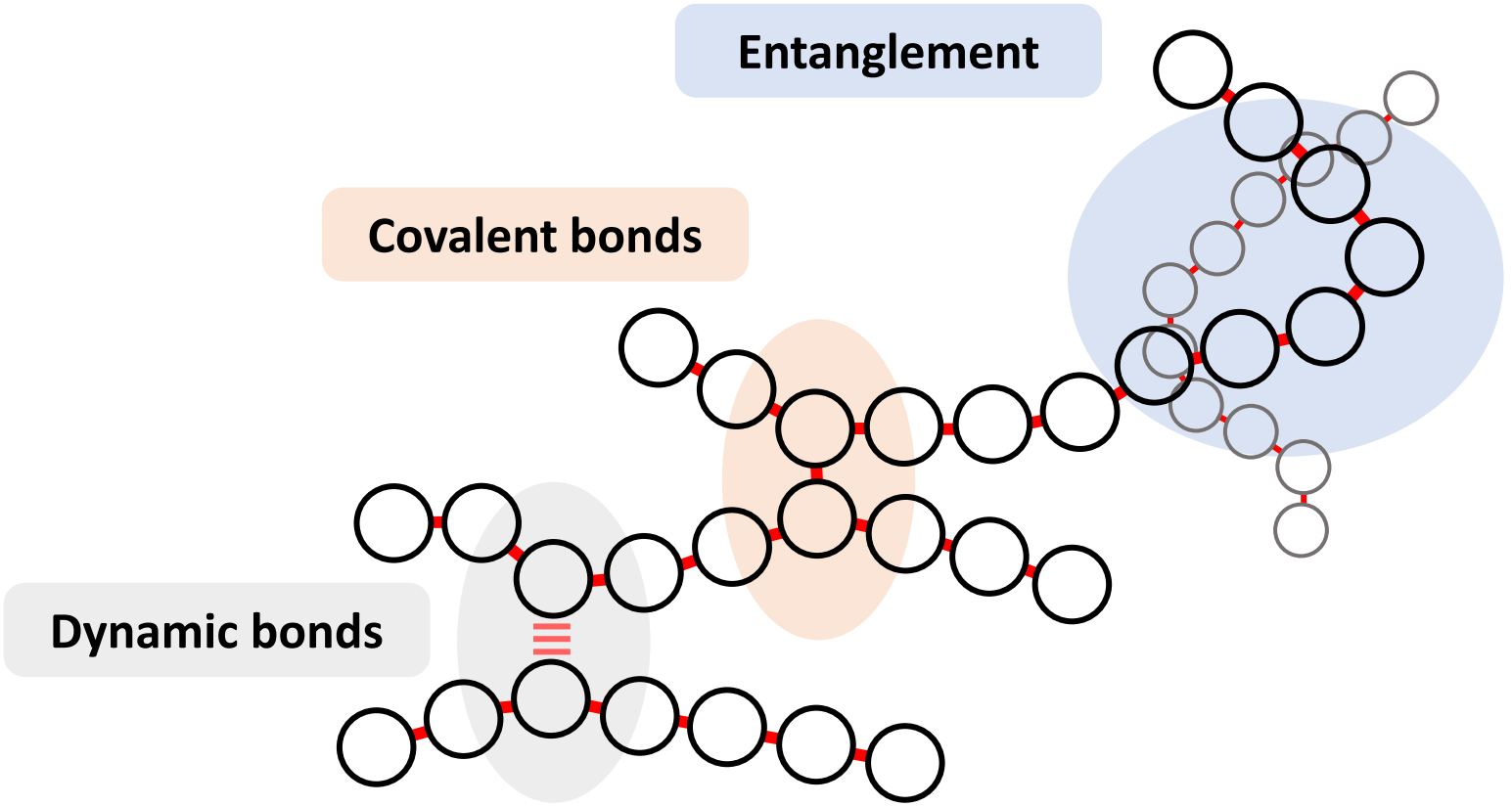
Level 4 on **IDDSI** scale:
thickest level for drinks*

4 ready-to-drink **cups**

5 thickening **powders**

Polymers from :

- **Plants** : guar, locust bean, pectin, …
- **Seaweeds** : carrageenan, alginate, …
- **Bacteria** : xanthan, gellan



* : Cichero, J. A. Y. *et al*. (2017). Development of International Terminology and Definitions for Texture-Modified Foods and Thickened Fluids Used in Dysphagia Management : The IDDSI Framework. *Dysphagia*, *32*(2), 293-314. https://doi.org/10.1007/s00455-016-9758-y

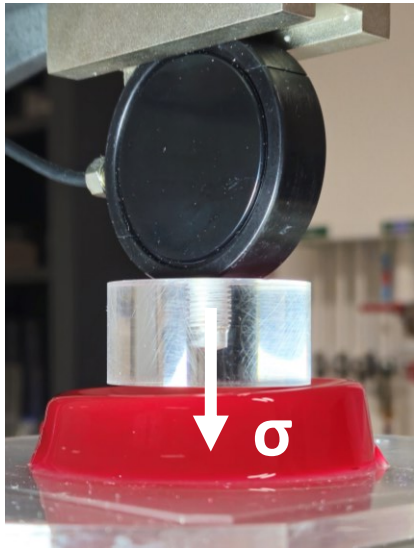
Aim

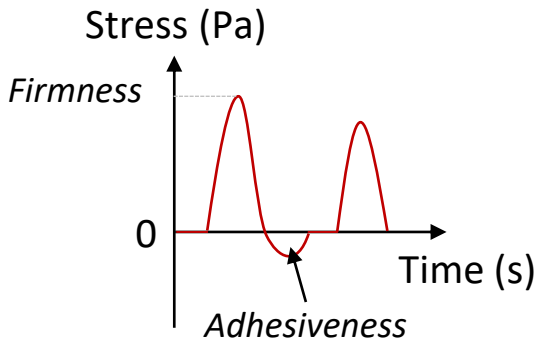
Structural and **mechanical** properties

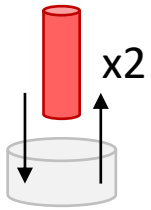
Sensory perception of texture

Innovative formulations

Compressive rheology

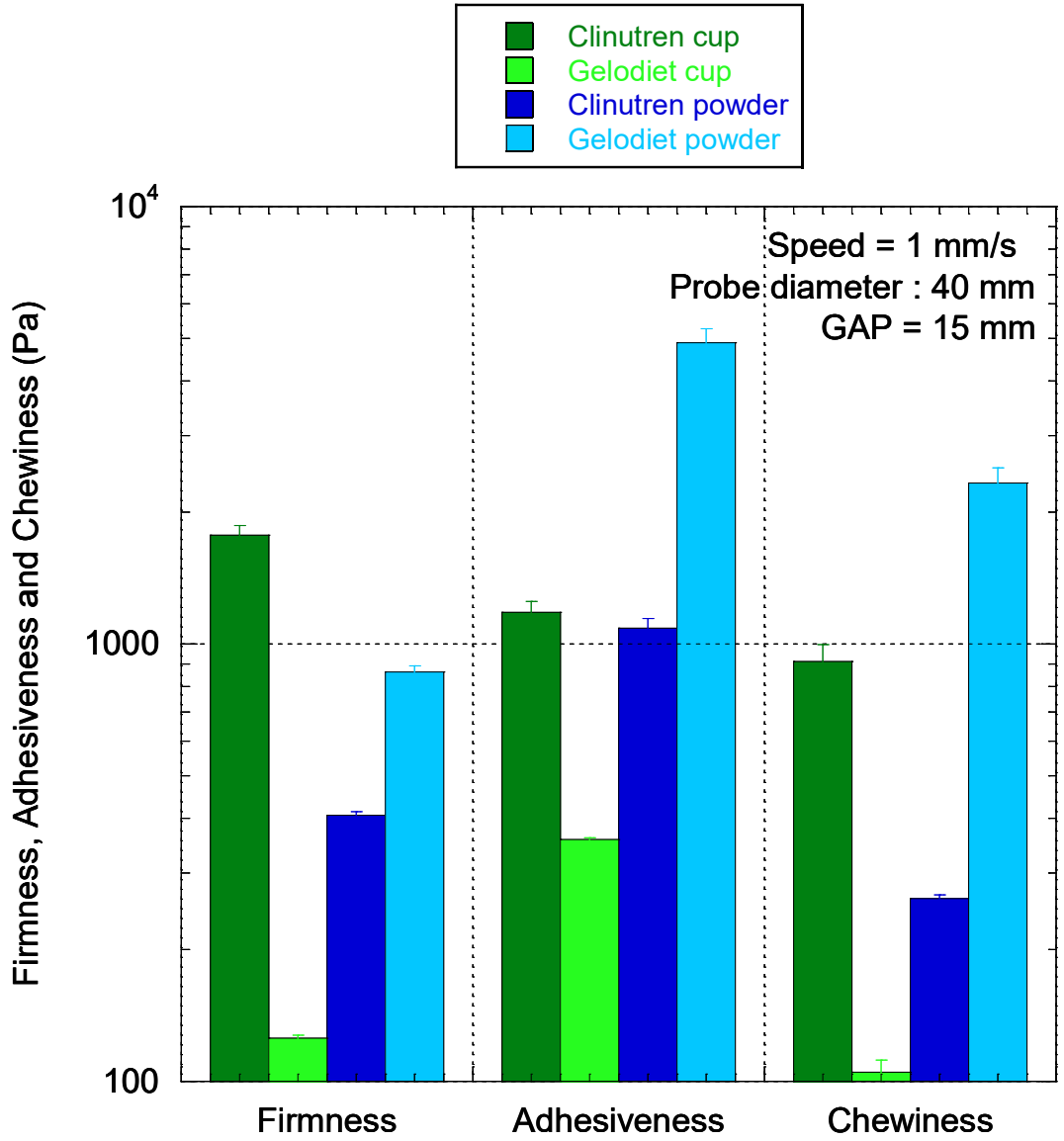






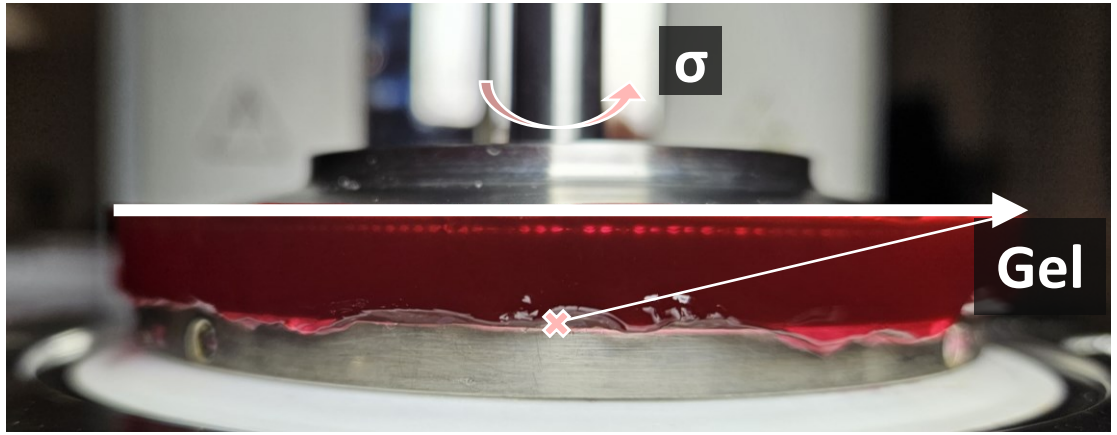
Texture Profile Analysis (TPA)* :

- Firmness
- Cohesiveness
- Springiness
- Gumminess
- Chewiness
- Adhesiveness



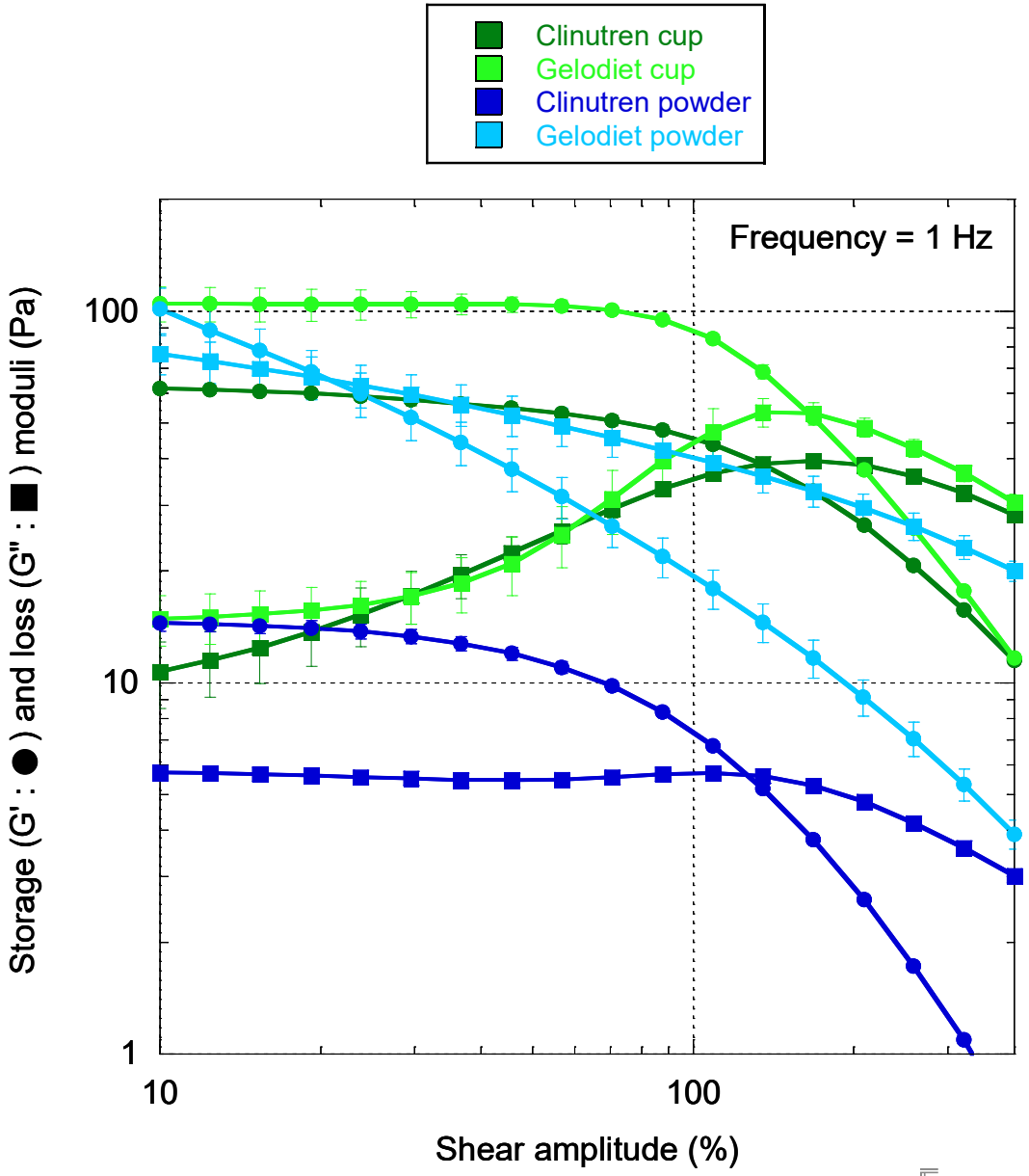
* : Scher, J. (2006). Rhéologie, texture et texturation des produits alimentaires. *Agroalimentaire*. https://doi.org/10.51257/a-v3-f3300

Shear rheology

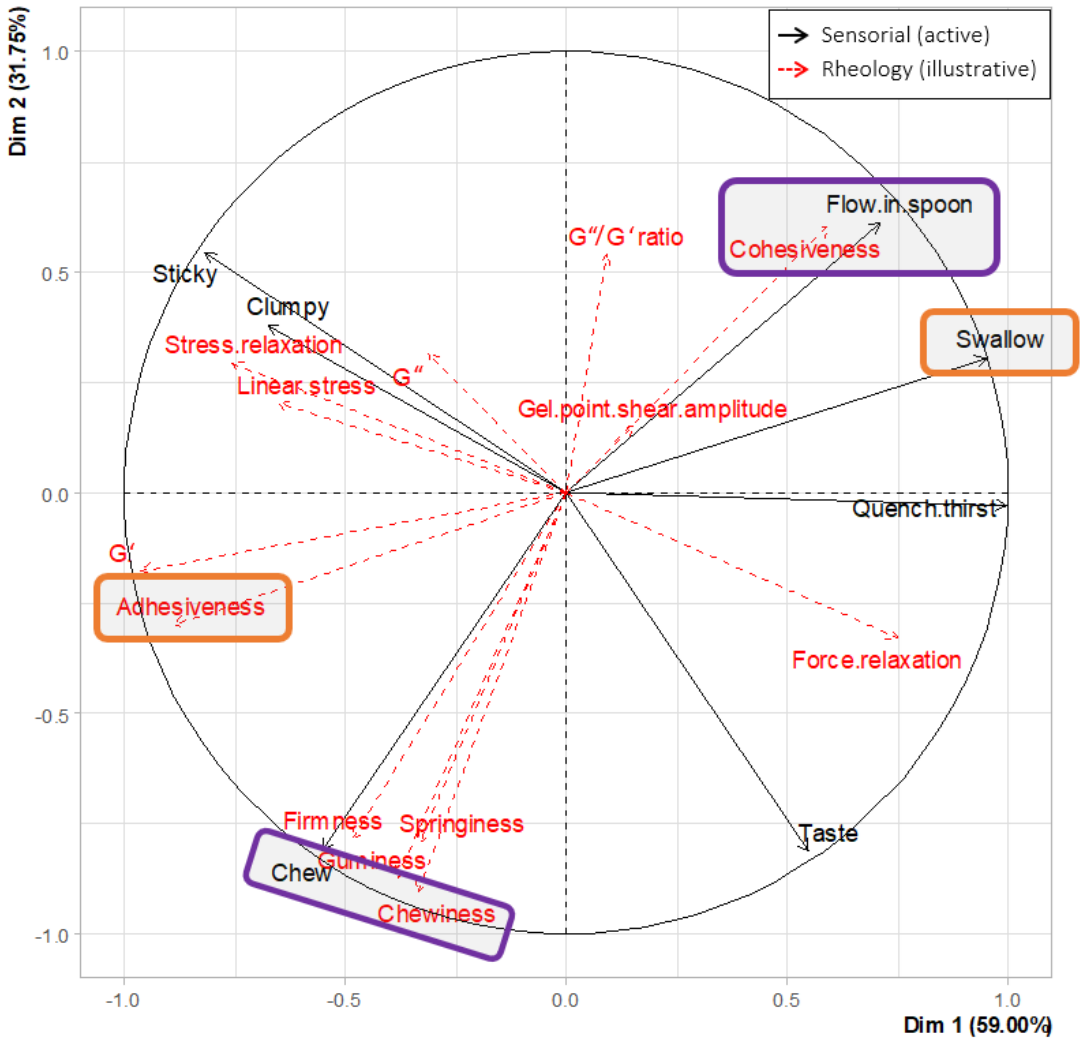


Shear continuous rate → Viscosity

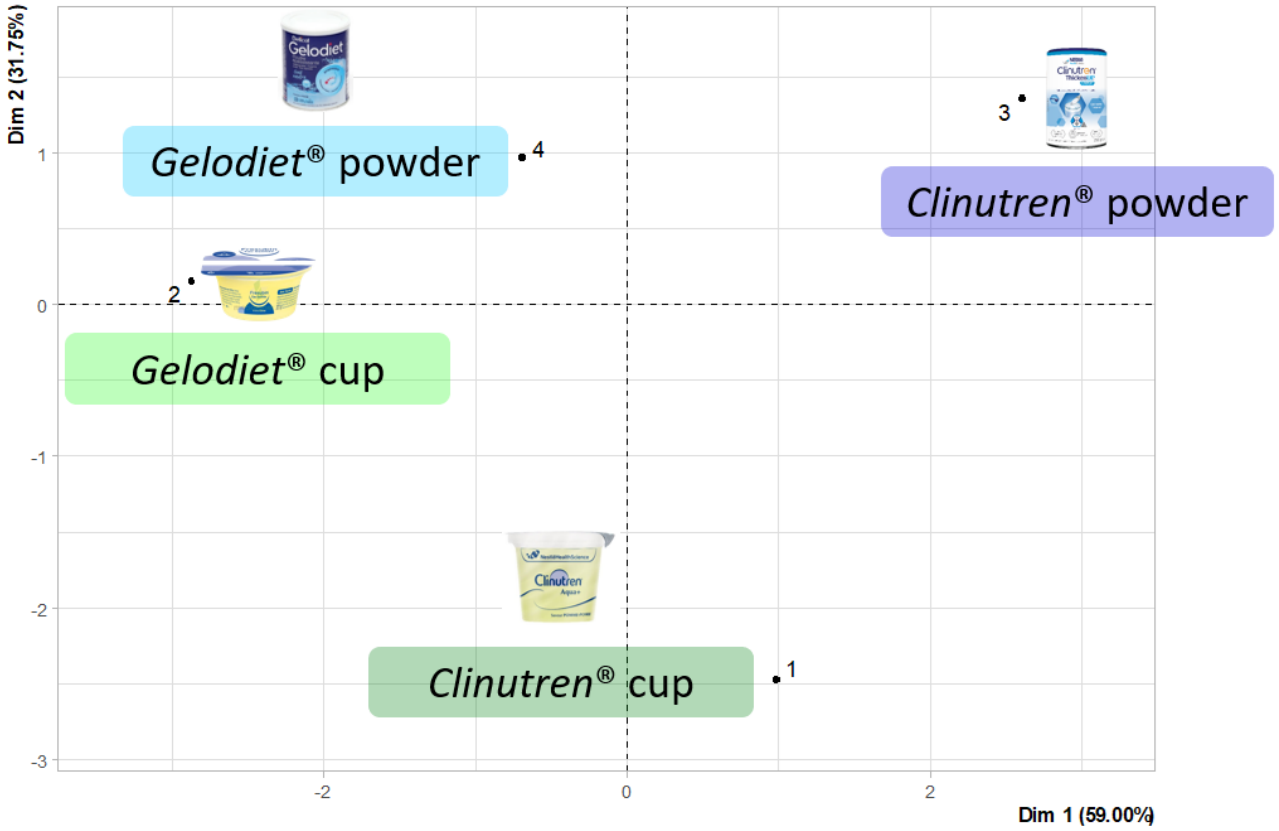
Amplitude sweep → Viscoelastic moduli



Prediction of hedonic perception

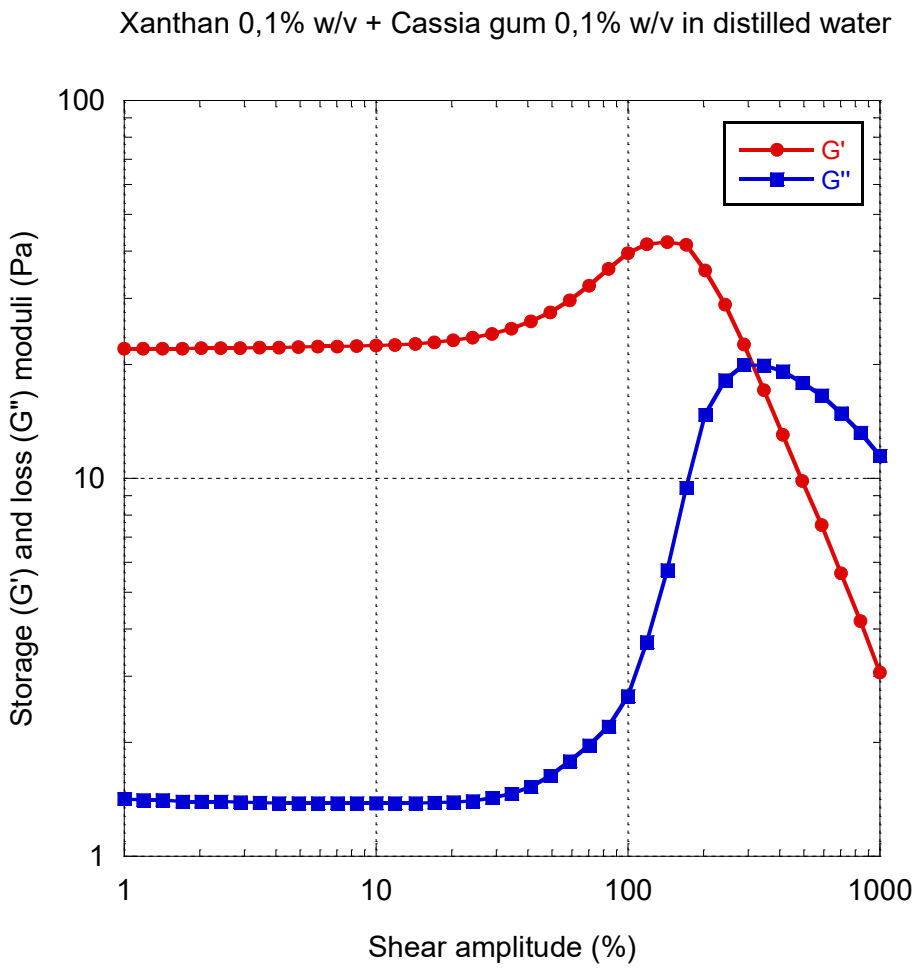


Sensorial analysis on 74 healthy volunteers



→ **Physical features** are correlated with **sensory perception**

Formulations



→ Original rheological behavior by mixing ingredients

Formulations with MICROPAQUE© = barium sulfate ($BaSO_4$) suspension

Level 3

1% w/v xanthan
40:60 MICROPAQUE©:water

Level 4

0,5% w/v xanthan
0,5% w/v carrageenan
40:60 MICROPAQUE©:water

Conclusion

- Level-4 ?
- Sensory perception correlated with rheological behavior
- New formulations
- Safety and swallowing time check by barium swallow test

Perspectives

- Design of experiments to find new synergies
- Objective sensory characterization by trained panelists
- Innovative characterizations

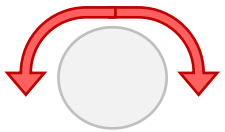
Thanks for your attention!

Annex: Rheological characterization

Rheometer MCR 301

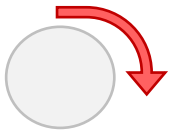
(Anton Paar, France)

Texturometer Lloyd Instruments TA1 (Ametek, France)



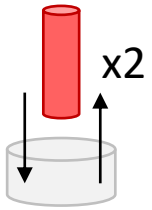
Amplitude sweep

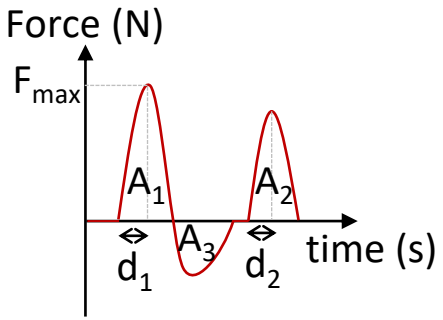
- G’ (Pa) : storage modulus
- G” (Pa) : loss modulus
- G’’/G’ ratio
- Linear stress (Pa)
- Gel point shear amplitude (%) : G’’=G’
- Exponent β [5] : $\frac{G''}{G'} = \tan\left(\frac{\pi * \beta}{2}\right)$



Stress relaxation (γ = 50%) *

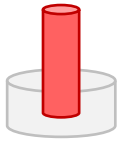
- Fitted by $y = a_r * x^{(-\beta_r)}$
- Stress relaxation = $\sigma_{30s} / \sigma_{0s}$





Texture Profile Analysis :

- Firmness = F_{max}
- Cohesiveness (C) = A_2 / A_1
- Springiness (S) = d_2 / d_1
- Gumminess (G) = $F_{max} * C$
- Chewiness = S * G
- Adhesiveness = A_3



Force relaxation (γ = 50%) *

- Fitted by $y = a_t * x^{(-\beta_t)}$
- Force relaxation = $\vec{F}_{30s} / \vec{F}_{0s}$

* : Ng T. S. K. & McKinley G. H., 2008, Power law gels at finite strains : The nonlinear rheology of gluten gels. Journal of Rheology, 52(2), 417-449. https://doi.org/10.1122/1.2828018

Annex: Hedonic evaluation

Only 4 products

Untrained panelists

74 adults, 9 descriptors / sample rated from 1 to 7

Random distribution : Williams square

Same taste (apple)

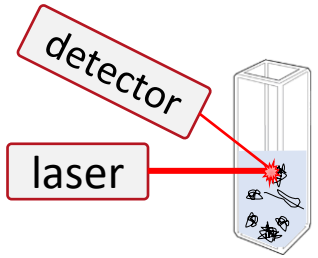
Before consumption :

Visual
Smell
Spoon flow

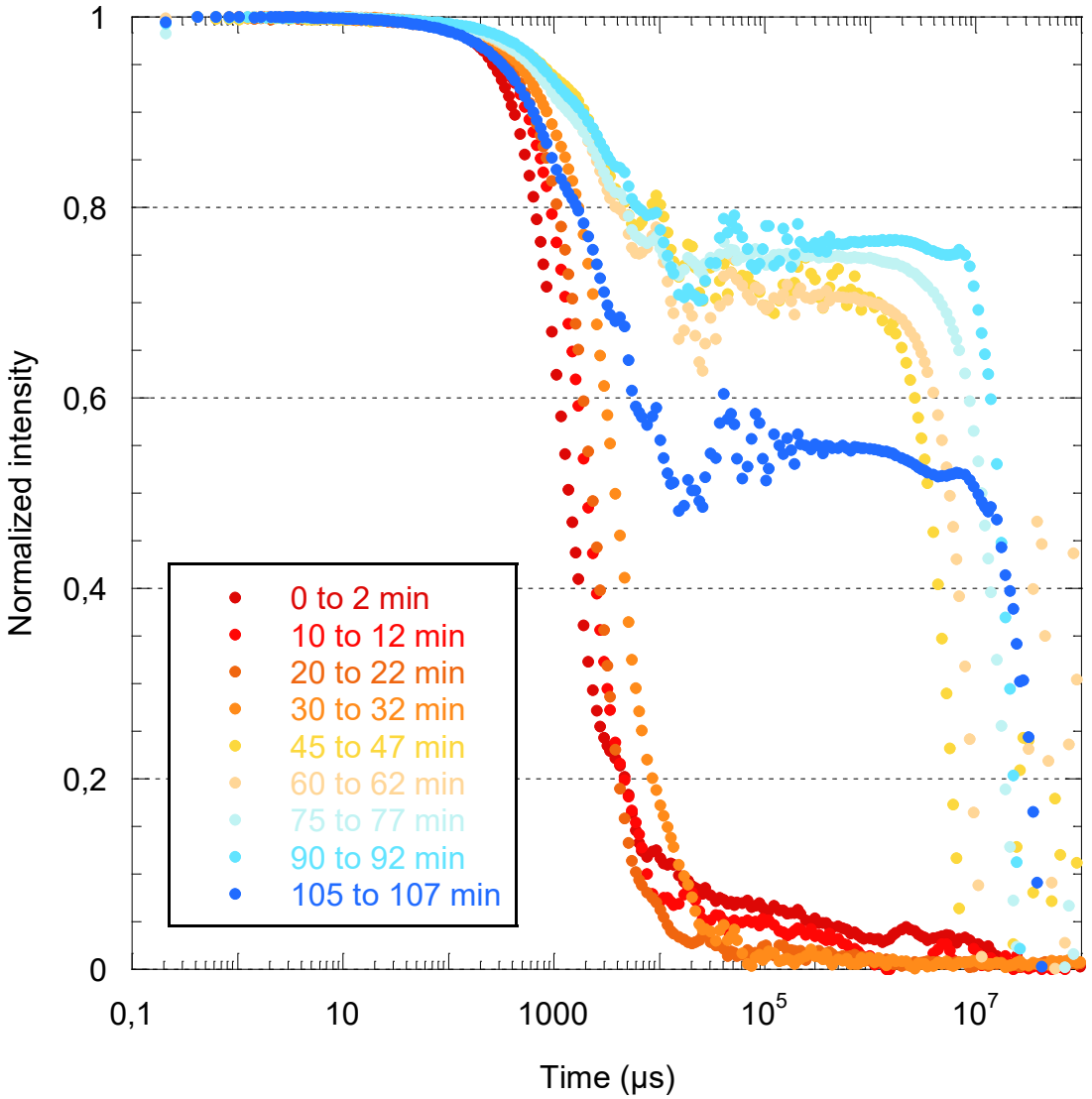
During consumption :

Taste
Clumpy
Sticky
Quench thirst
Swallowing difficulties
Chew sensation to swallow

Annex: Gelation kinetics



Dynamic Light Scattering (DLS)



Frequency = 1 Hz
Shear amplitude = 1%