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Soft plant cells suspensions: How does structural parameters and continuous phase impact rheological behaviour?

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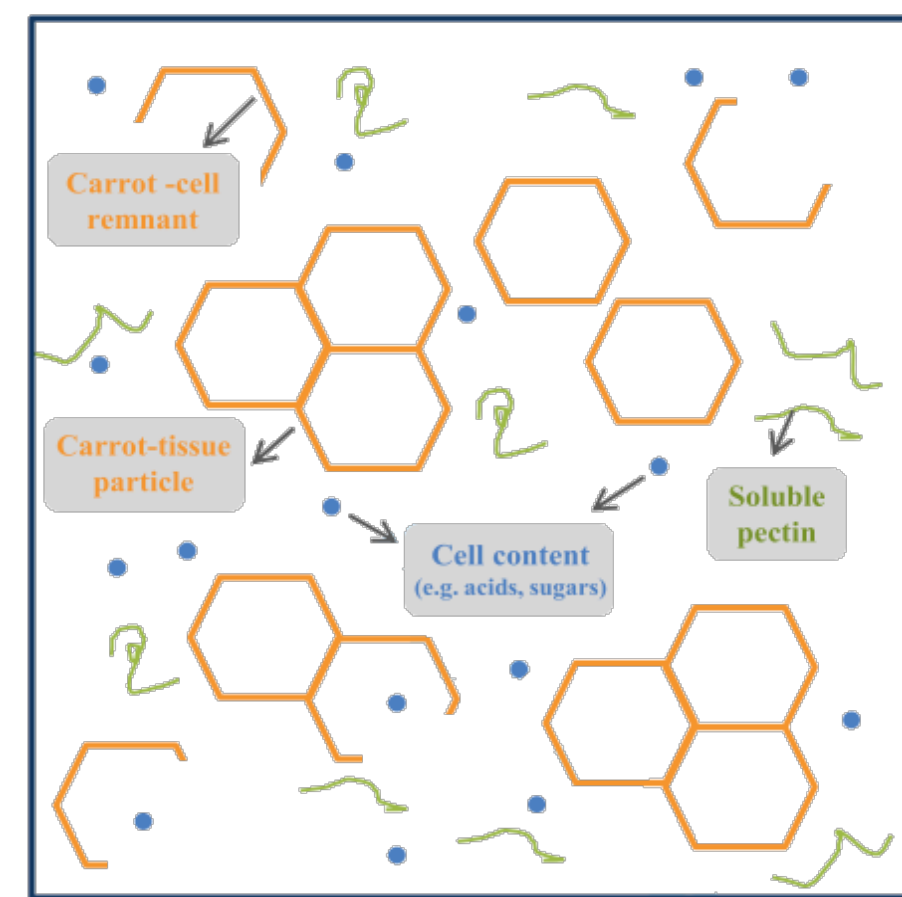
UMR Ingénierie Procédés Aliments (JRU Food & Process Engineering)

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COMPLEX SYSTEM

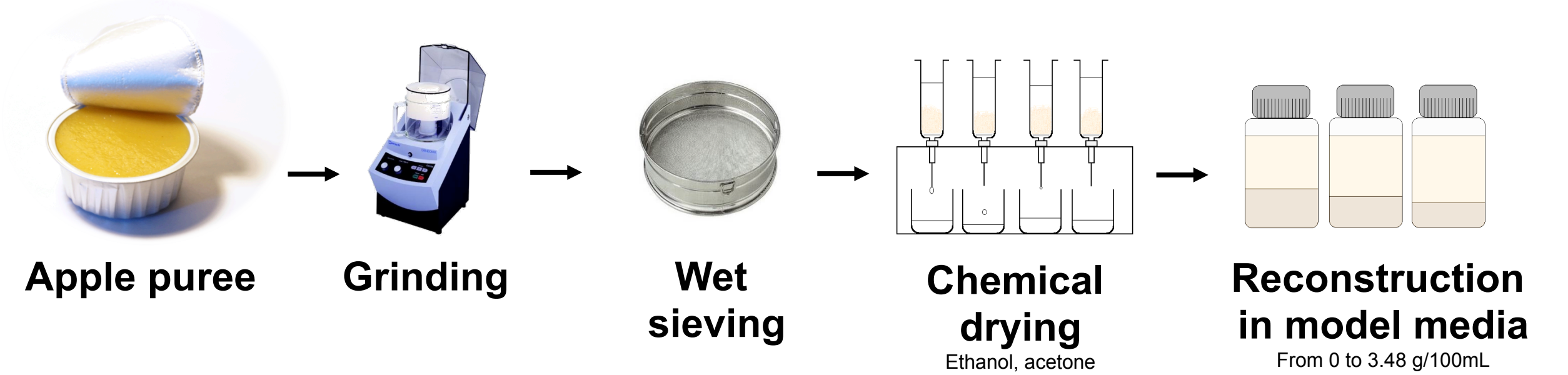
Fruit or vegetable puree =
Concentrated suspension of plant particles

- ✓ Continuous phase = Aqueous serum containing sugar and soluble pectins
- ✓ Dispersed phase = cell clusters/ individual cells / cell fragments from parenchyma



ISOLATION OF CELL WALLS

MODEL SYSTEM



2 PARTICLE SIZE DISTRIBUTIONS SELECTED

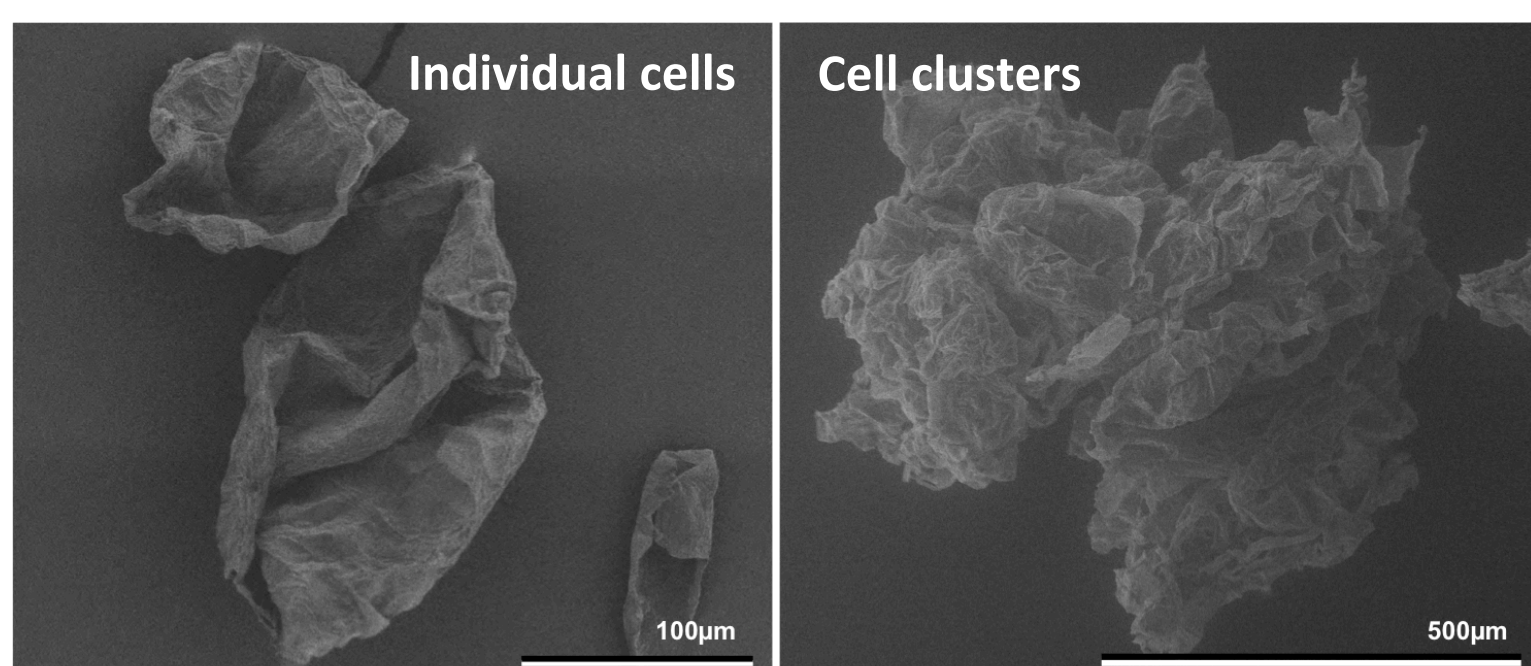
5 MODEL MEDIA

	Viscosity at 100s ⁻¹ mPa.s	Density at 25° C	Conductivity μS/cm
Water	1.0 ± 0.2	1.000	0.80 ± 0.1
NaCl 0.1%	1.1 ± 0.2	1.000	1751 ± 15
Sucrose 48%	12.8 ± 0.3	1.219	18 ± 1
CMC 1%	12.6 ± 0.1	1.006	2000 ± 30
CMC 3.2%	108 ± 2	1.018	6000 ± 210
Apple Serum	13 ± 2	1.051	1731 ± 22

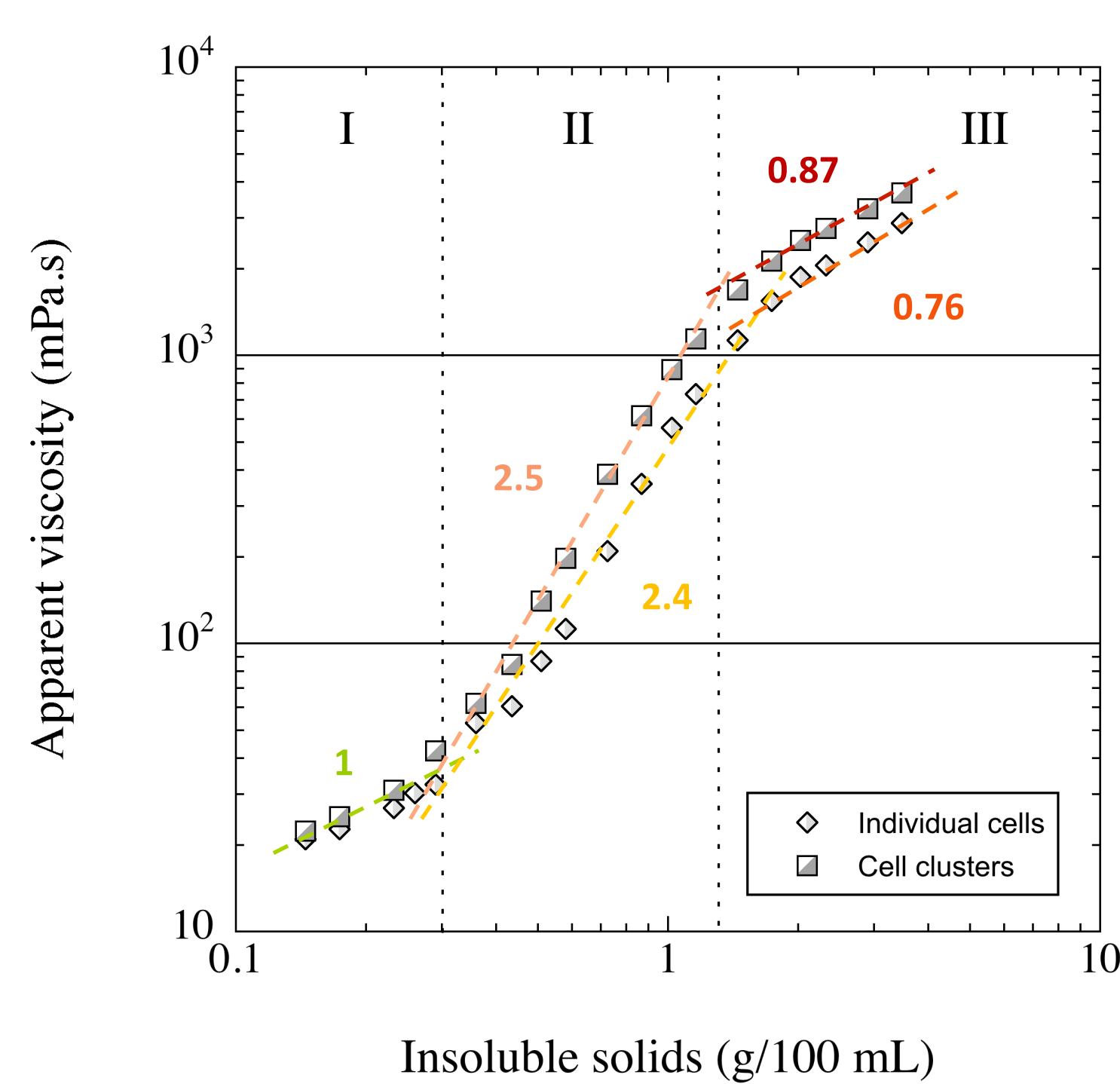
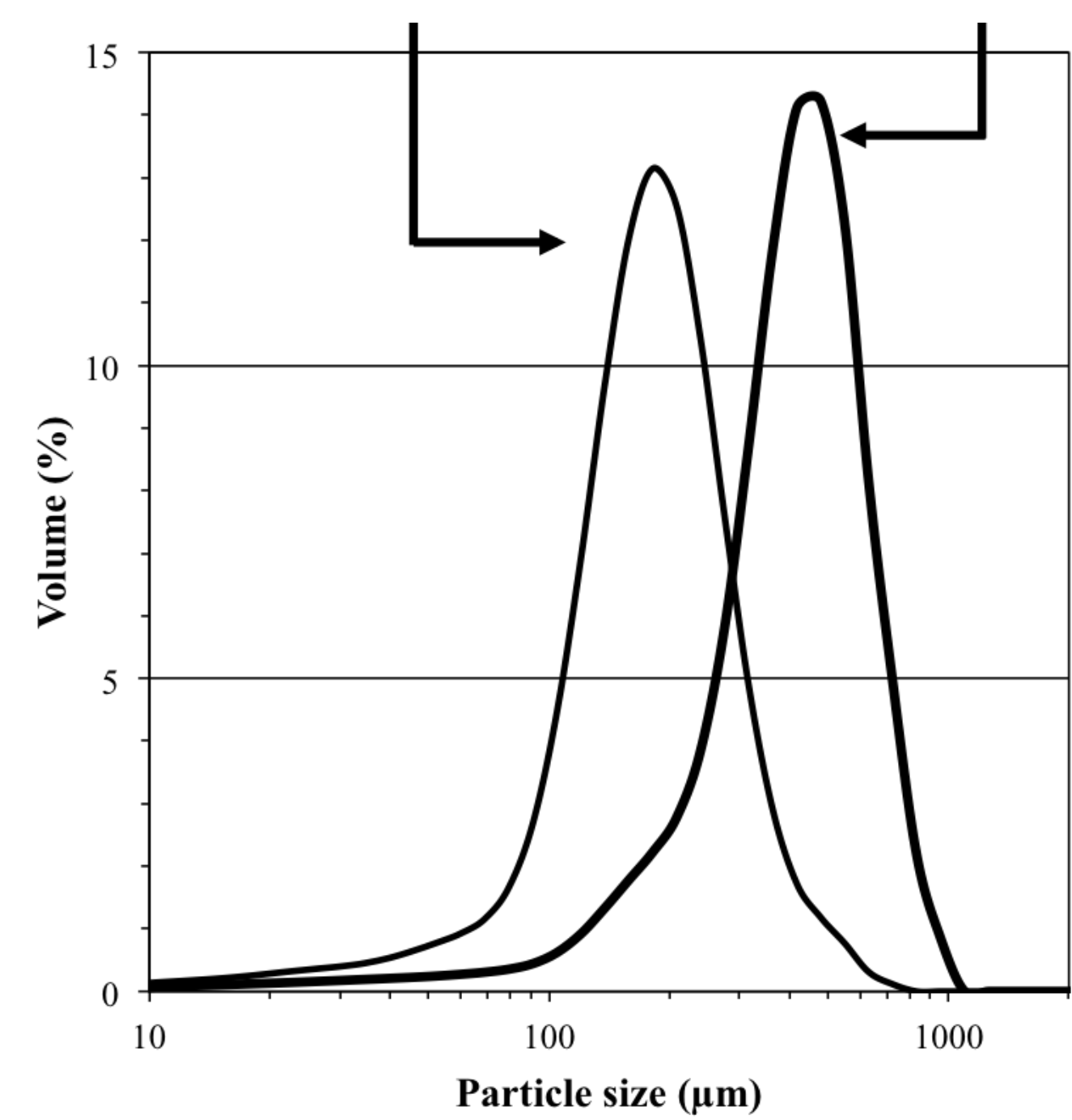
Research questions:

- ✓ What is the impact of particle morphology ?
- ✓ What is the role of the continuous phase ?

Impact of particle morphology



Clusters are more irregular in shape than individual cells. Moreover, their complex architecture can lead to a higher rigidity



Three concentration domains are highlighted both for individual cells and clusters

- ✓ Diluted – No interactions between particles
- ✓ Intermediate – Weak network
- ✓ Concentrated – Packing

Clusters induce higher viscosities at same cell wall content

➔ because of their irregular shape ?

Conclusions

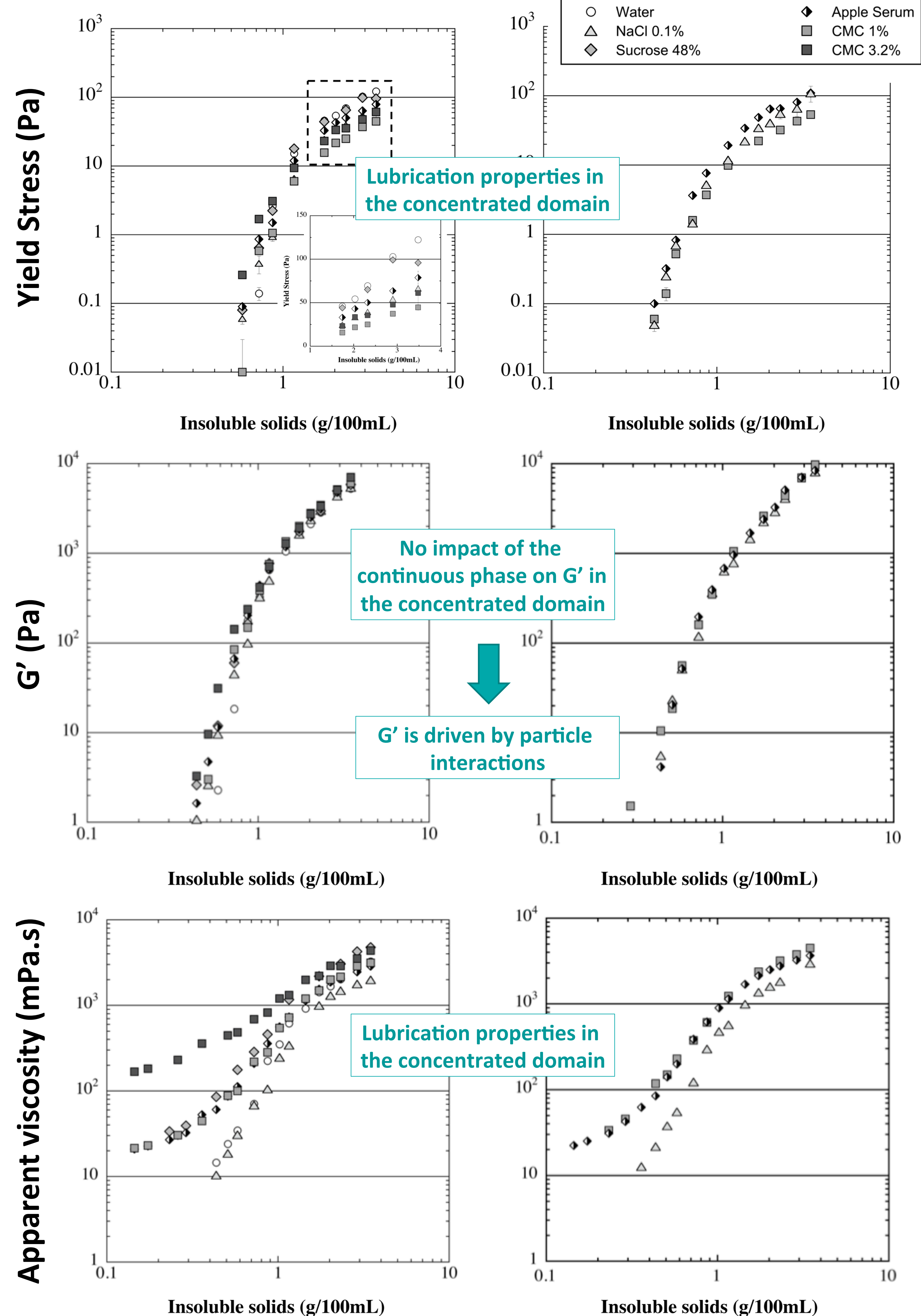
- ✓ Model suspensions successfully reproduce the rheological behaviour of real purees
- ✓ At rest, rheological properties of concentrated suspensions are controlled by the particles, but the yield stress and the flow properties are sensitive to the composition of the continuous phase
- ✓ A lubricating effect of the continuous phase is observed in the concentrated domain

On yield stress values & On apparent viscosity

Impact of continuous phase

Individual cells

Cell clusters



REFERENCES

Day et al., Food and Bioprocess Technology, 3, 928–934, (2010).