Laboratory of Food Chemistry and Biochemistry
Leuven Food Science and Nutrition Research Centre

Self-assembly of oat proteins in various colloidal states as function of the NaCl concentration

A.G.B. Wouters [a*] (arno.wouters@kuleuven.be), Taco Nicolai [b]

[a] Laboratory of Food Chemistry and Biochemistry and Leuven Food Science and Nutrition Research Centre (LFoRCe), KU Leuven, 3001 Leuven, Belgium
[b] Le Mans Université, IMMM UMR-CNRS 6283, Polymères, Colloïdes et Interfaces, Le Mans, France

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Introduction & Objective

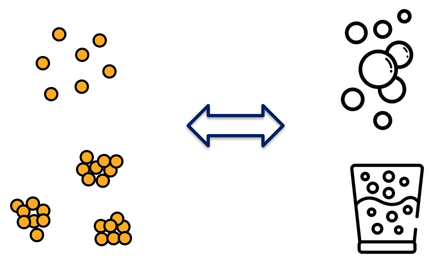
Oats are increasingly used in liquid and semi-solid foods such as dairy alternatives

The protein content in oat-based dairy alternatives is often low [1]

Most (if not all) oats are heat-treated prior to use in foods [2]

Thus, most studies on oat proteins have not focused on native oat proteins

The colloidal state of plant proteins affects their functionality in food systems [3]



Objective

To investigate the **colloidal state** of **native oat proteins** in **food system relevant conditions**

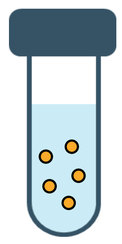
Experimental set-up

1 Protein isolation

Non-heat-treated oats → Milling, Hexane defatting → Defatted oat flour → Protein extraction at pH 9.0, Protein precipitation at pH 4.5, Neutralization and freeze drying → Oat protein isolate (OPI)

~ 79% protein (w/w dry matter)
At least ~79% of the proteins are 12S globulins

2 Approach

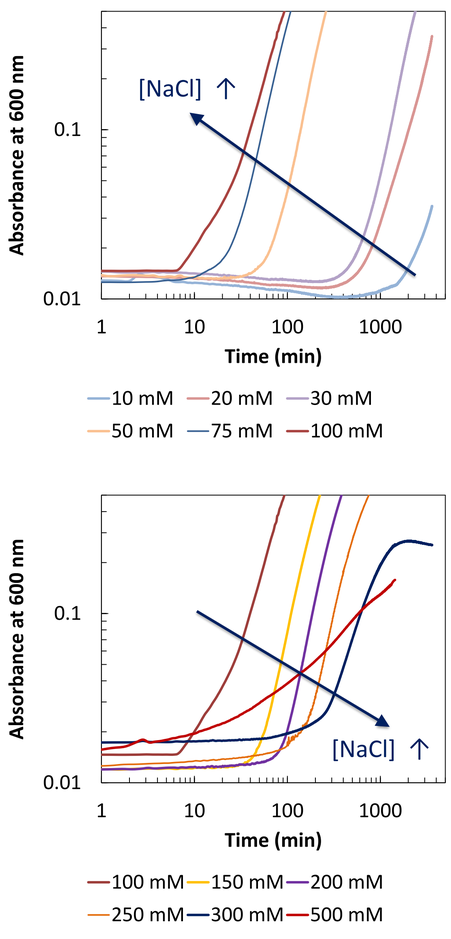
OPI → Solubilization at pH 10.0, **Centrifugation (50,000 *g* – 4 h)** →  Unaggregated oat protein solution → **Addition of NaCl 0 – 1000 mM**

Characterization with
- Turbidity measurements
- Confocal laser scanning microscopy
- Static and dynamic light scattering

Results

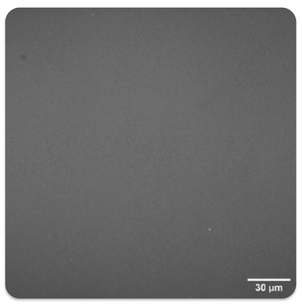
Turbidity measurements

Turbidity as function of time for OPI dispersions containing 10 – 500 mM NaCl



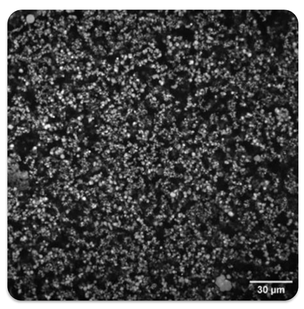
Confocal laser scanning microscopy

OPI dispersions containing 0 – 30 mM NaCl

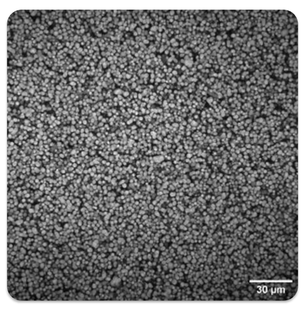


0.45% $w_{protein}$/v
30 mM NaCl

OPI dispersions containing 30 – 300 mM NaCl

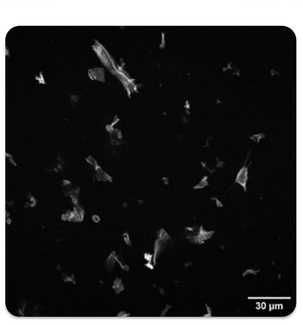


0.45% $w_{protein}$/v
50 mM NaCl



1.35% $w_{protein}$/v
150 mM NaCl

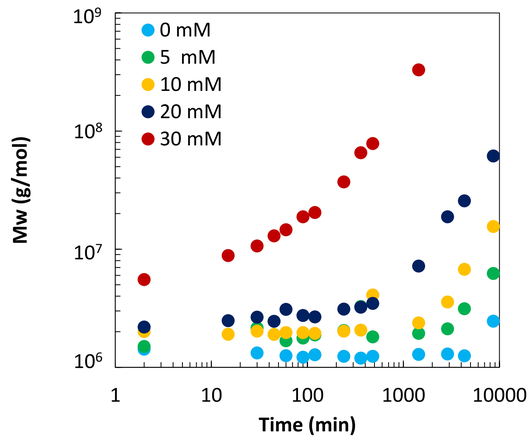
OPI dispersions containing ≥ 500 mM NaCl



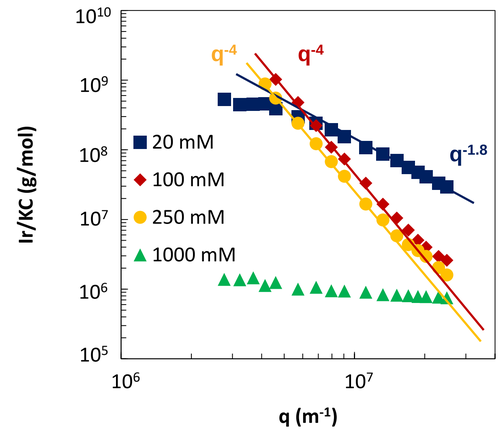
0.45% $w_{protein}$/v
1000 mM NaCl

Light scattering

Average molecular weight as function of time for OPI dispersions containing 0 – 30 mM NaCl

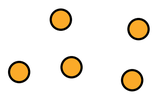
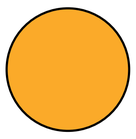


Static light scattering intensity as function of scattering angle for OPI dispersions containing 0 – 1000 mM NaCl



Conclusions

Oat proteins self-assemble into various colloidal states at different NaCl concentrations

0 mM NaCl	0 – 30 mM NaCl	50 - 300 mM NaCl
		
Single molecules	**Fractal aggregation**	**Microphase separation**

→ Impact in food systems?
Impact on protein functionality?
Other environmental conditions?

References: [1] Walther et al. (2022), Front. Nutr. 9, https://doi.org/10.3389/fnut.2022.988707. [2] Runyon et al. (2015), J Cereal Sci 65, 119-124, https://doi.org/10.1016/j.jcs.2015.06.008. [3] Schmitt et al. (2021), Curr. Opin. Coll. Int. Sci., 56, 101510, https://doi.org/10.1016/j.cocis.2021.101510.

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