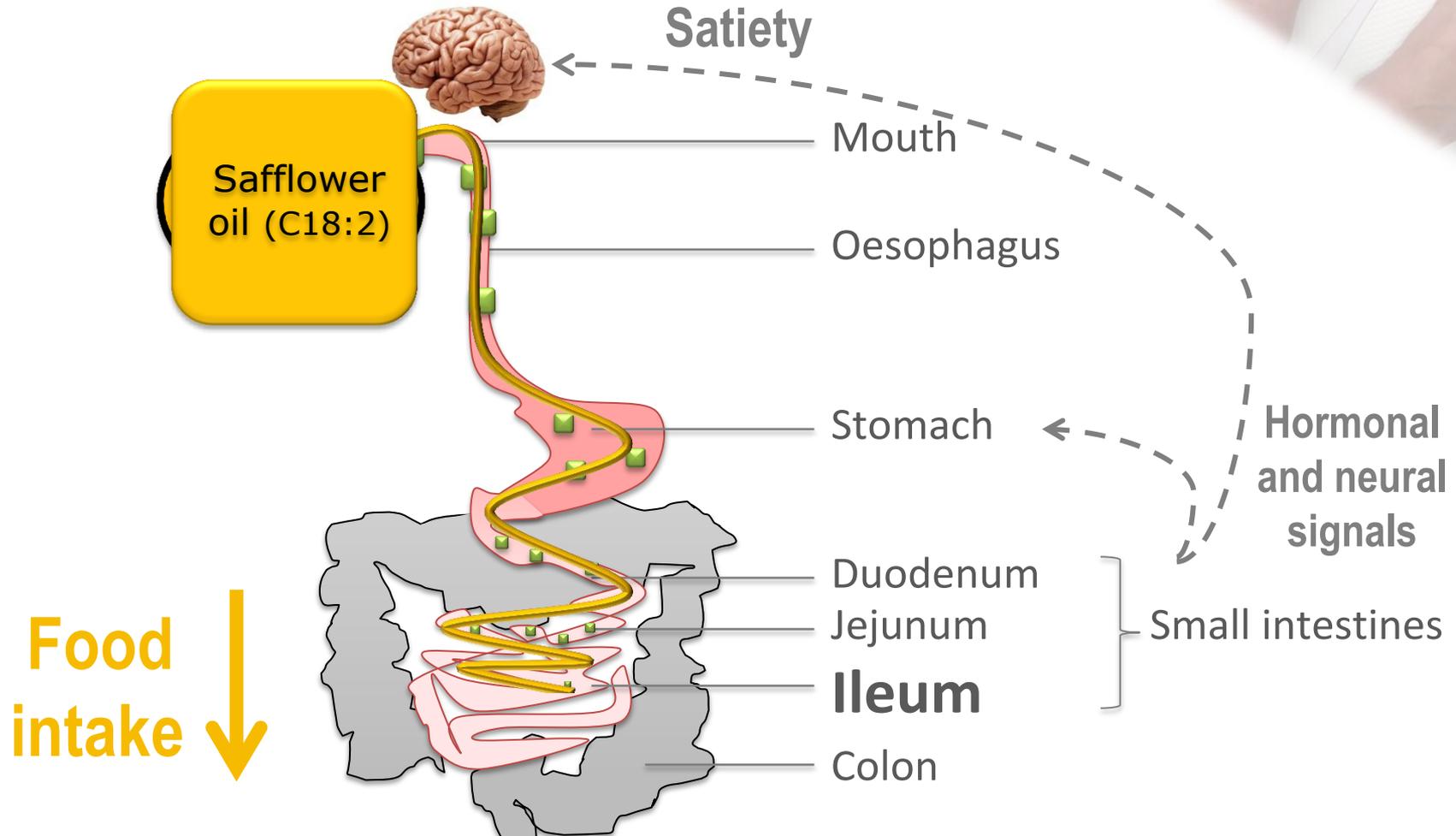




# Multilayered interfaces to delay *in vitro* lipolysis in O/W emulsions

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# Natural mechanism to induce satiety





CrossMark

← click for updates

Original Articles

## Food-grade Micro-encapsulation Systems that May Induce Satiety via Delayed Lipolysis: A Review

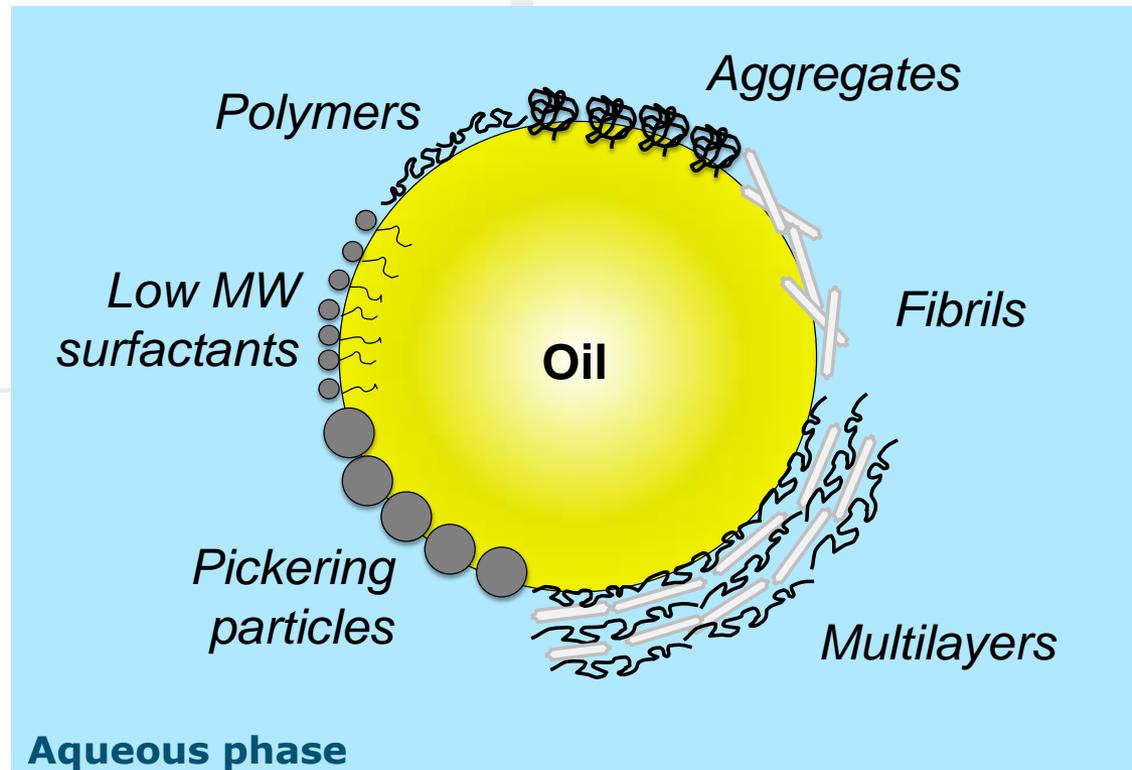
DOI: 10.1080/10408398.2015.1057634

Meinou N. Corstens<sup>\*ab</sup>, Claire C. Berton-Carabin<sup>ab</sup>, Renko De Vries<sup>ac</sup>, Freddy J. Troost<sup>d</sup>, Ad A.M. Masclee<sup>d</sup> & Karin Schroën<sup>ab</sup>  
**Publishing models and article dates explained**

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# Multilayered emulsions – *in vitro* lipolysis

Second layer chitosan ↓

Klinkesorn, U., & McClements, D. J. (2010). *Food Biophysics*, 5, 73–81.

Second layer chitosan ↓  
Third layer pectin ↑

Mun, S., et al. (2006). *Food Biophysics*, 1, 21–29.

Second layer chitosan ↓  
Third layer pectin -  
Third layer alginate -

Li, Y., et al. (2010). *Eur. J. Pharm. Biopharm.*, 76, 38–47.

Second layer caseinate ↑

Second layer lactoferrin ↑

Lesmes, U., Baudot, P., & McClements, D. J. (2010). *J. Agric. Food Chem.*, 58, 7962–9.

Second layer pectin -  
Third layer chitosan ↓  
Fourth layer pectin -

Hu, M., et al. (2011). *Food Biophysics*, 6, 37–48.

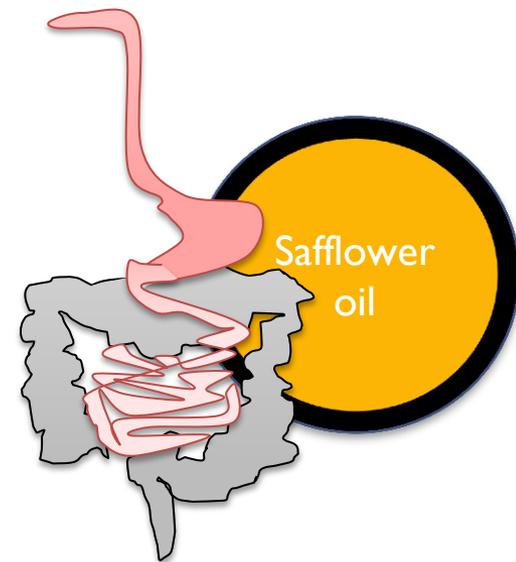
Third layer chitosan ↑

Li, Y., & McClements, D. J. (2014). *Food Hydrocolloids*, 40, 96–103.

↑ Increased  
- No effect  
↓ Decreased

# Objective

To gain insight in the stability of multilayered emulsions under conditions relevant to the gastrointestinal tract

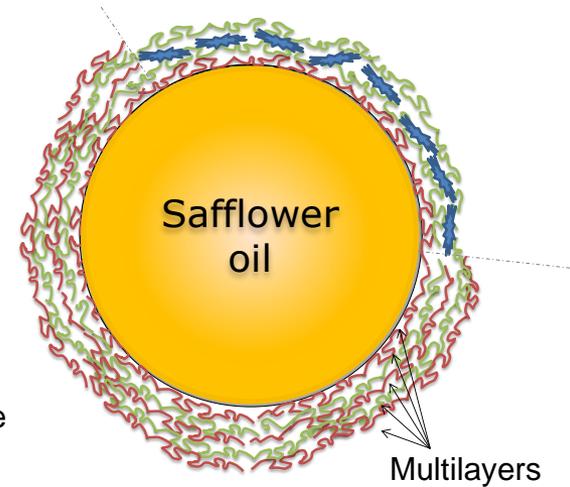
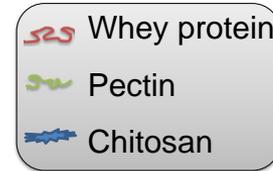


# Approach

## 1. Production

Electrostatic layer-by-layer adsorption

- At pH 3.0
- 1 to 5 layers
- WPI/pectin (chitosan)



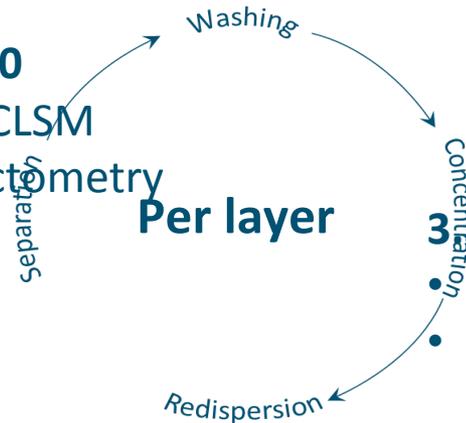
## 2. Characterisation pH 3.0

- Emulsion – Charge & CLSM
- Model surface – reflectometry

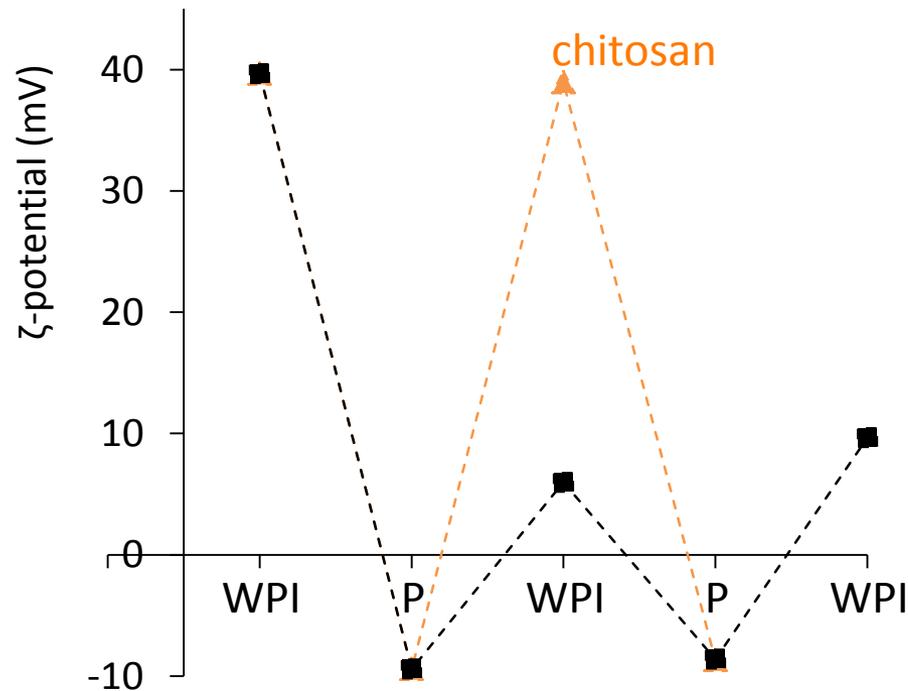
Per layer

## 3 Behaviour digestive conditions

- Model surface – reflectometry
- Emulsion (*in vitro*)
  - pH stability
  - Gastric stability
  - Intestinal lipolysis

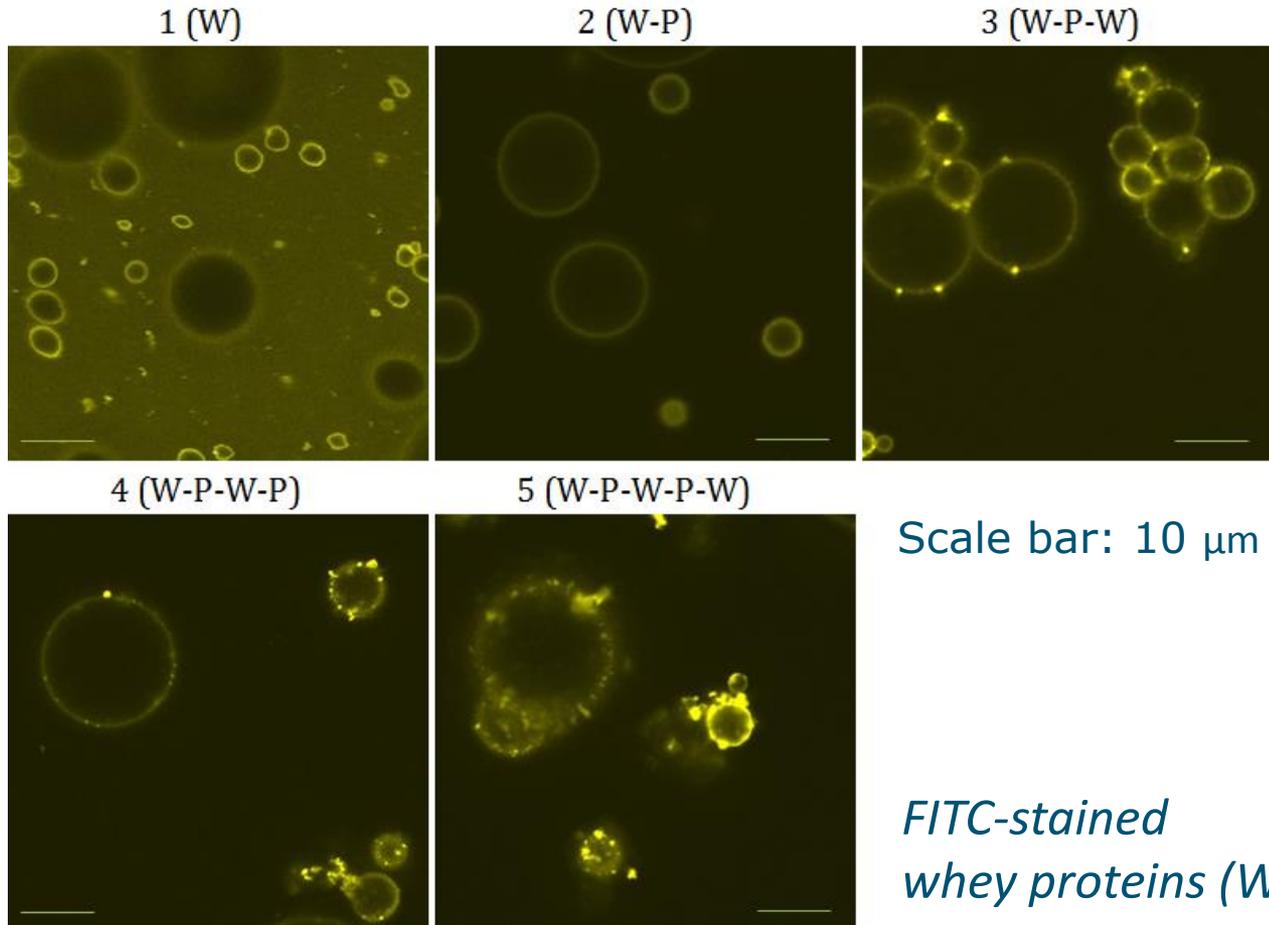


# Charge - inversion confirmed adsorption



# Protein location - heterogeneous

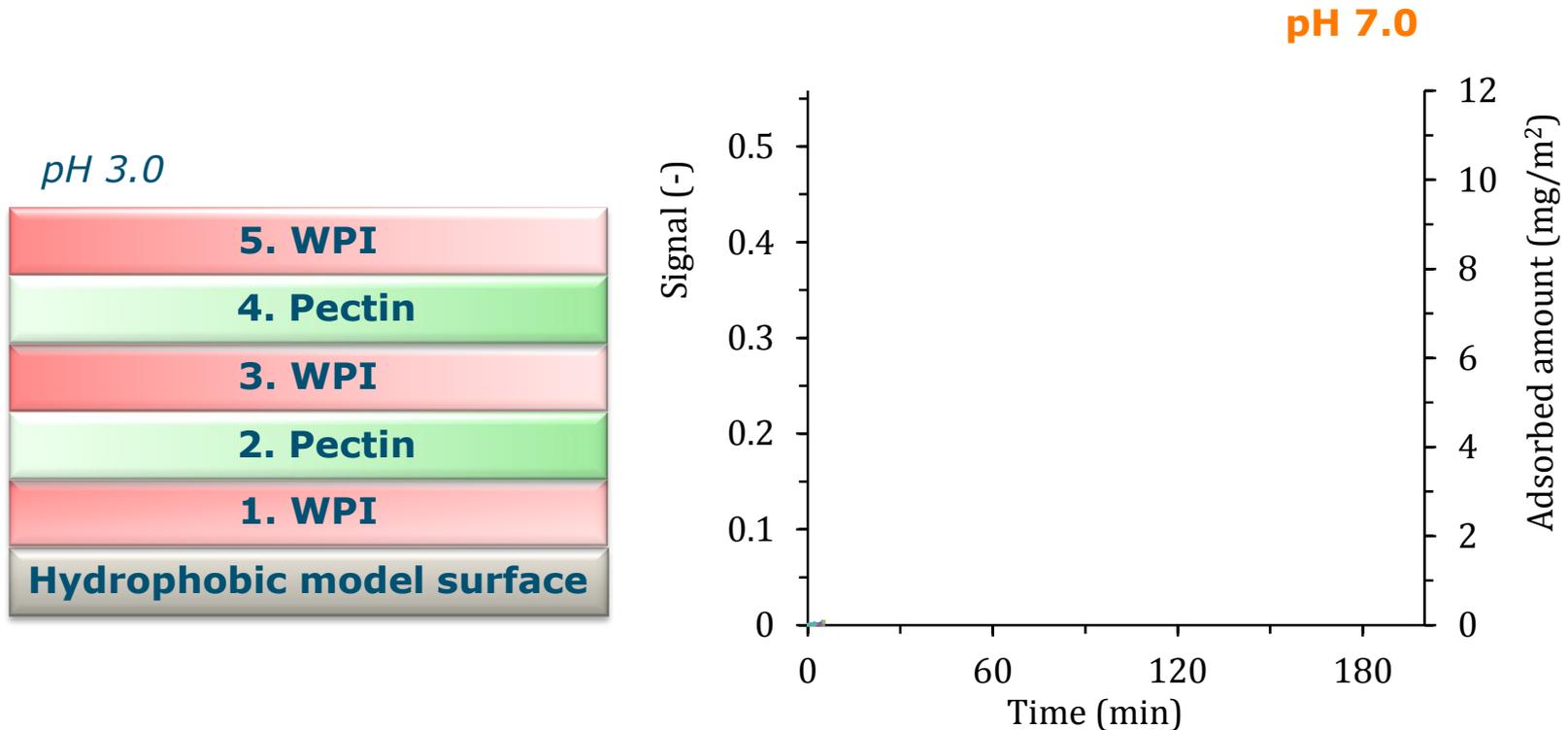
CLSM



# Adsorbed amount

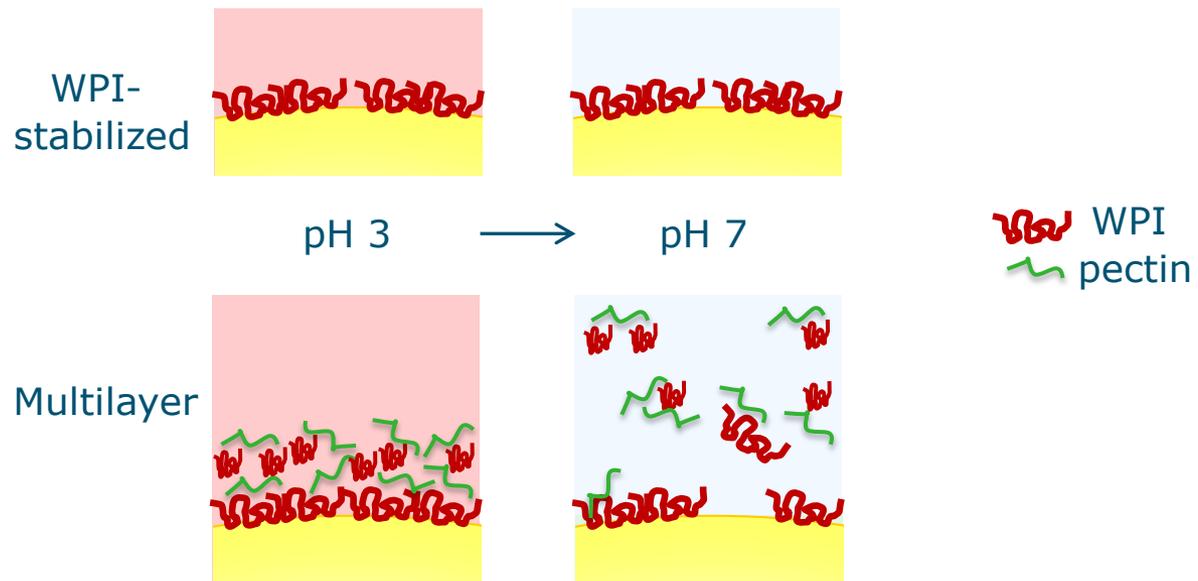
increased with # layers

Reflectometry



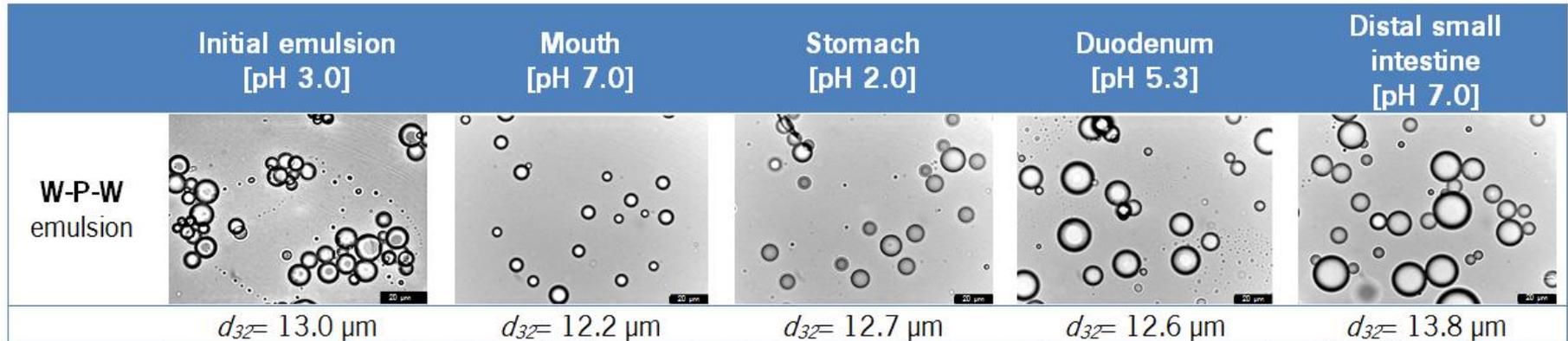
.. but destabilized at intestinal pH





# pH stability

better without chitosan

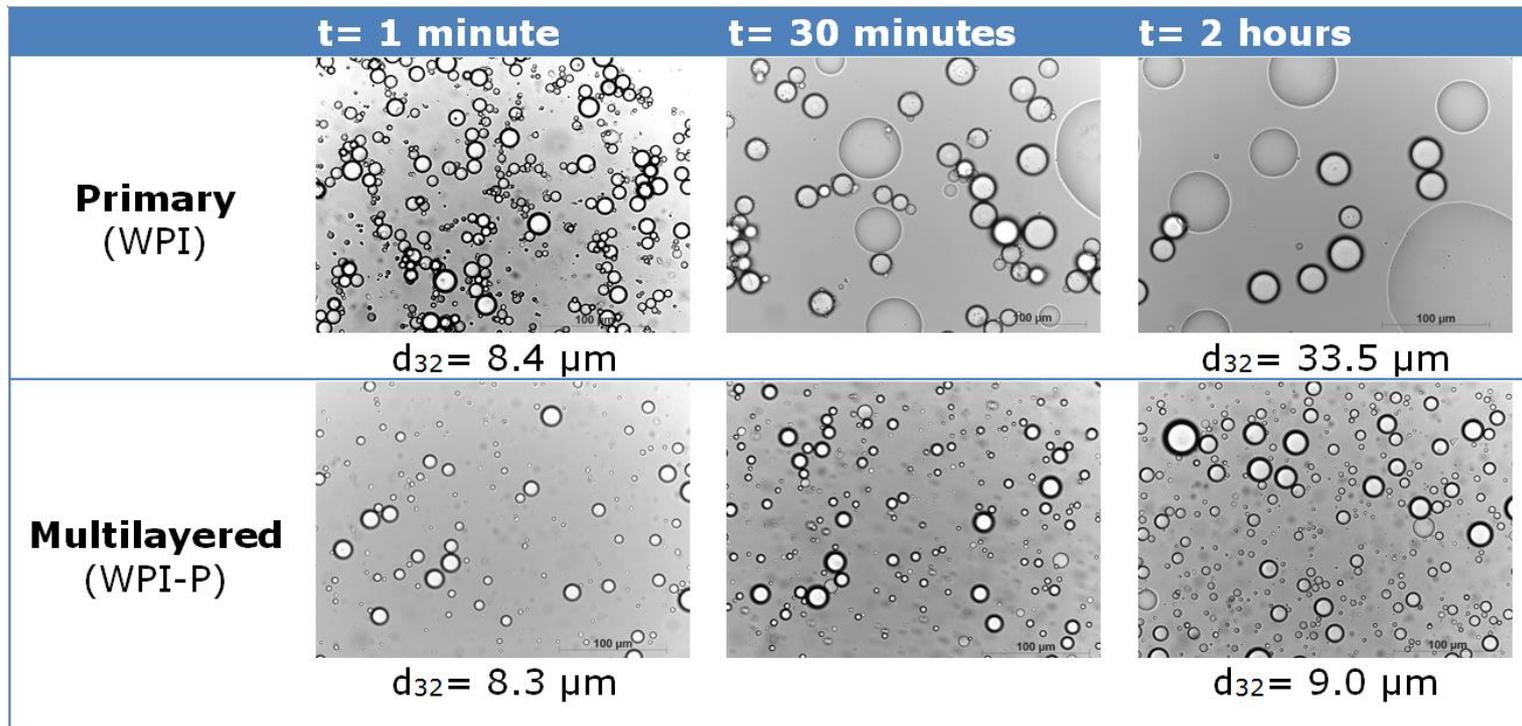


# Gastric stability

0.5 mg/mL pepsin

150 mM NaCl | 10 mM CaCl<sub>2</sub>

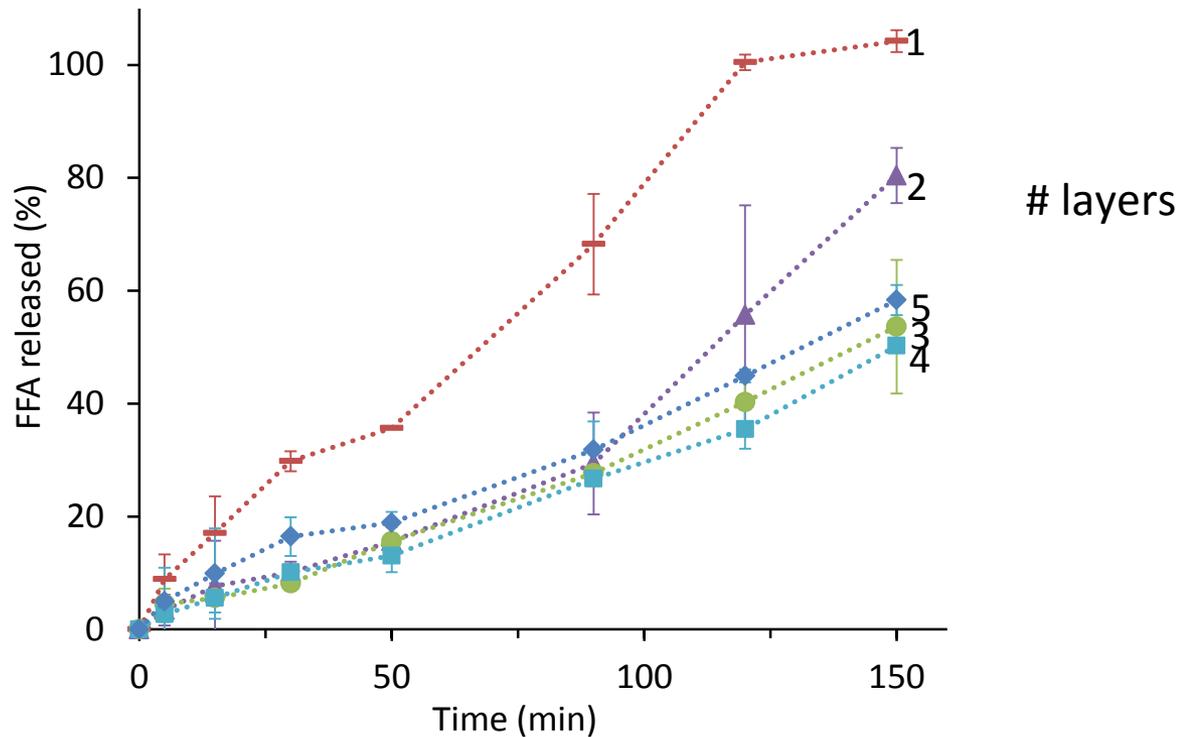
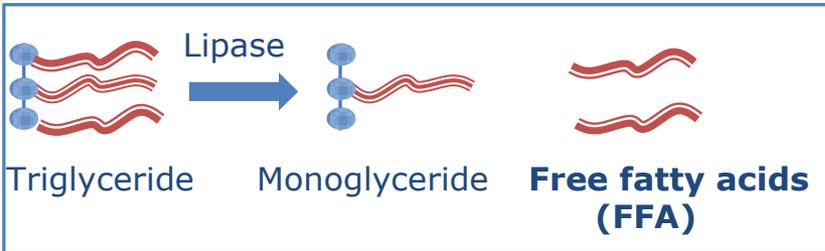
pH 3.0 | 2h | 37 °C



# In vitro intestinal lipolysis

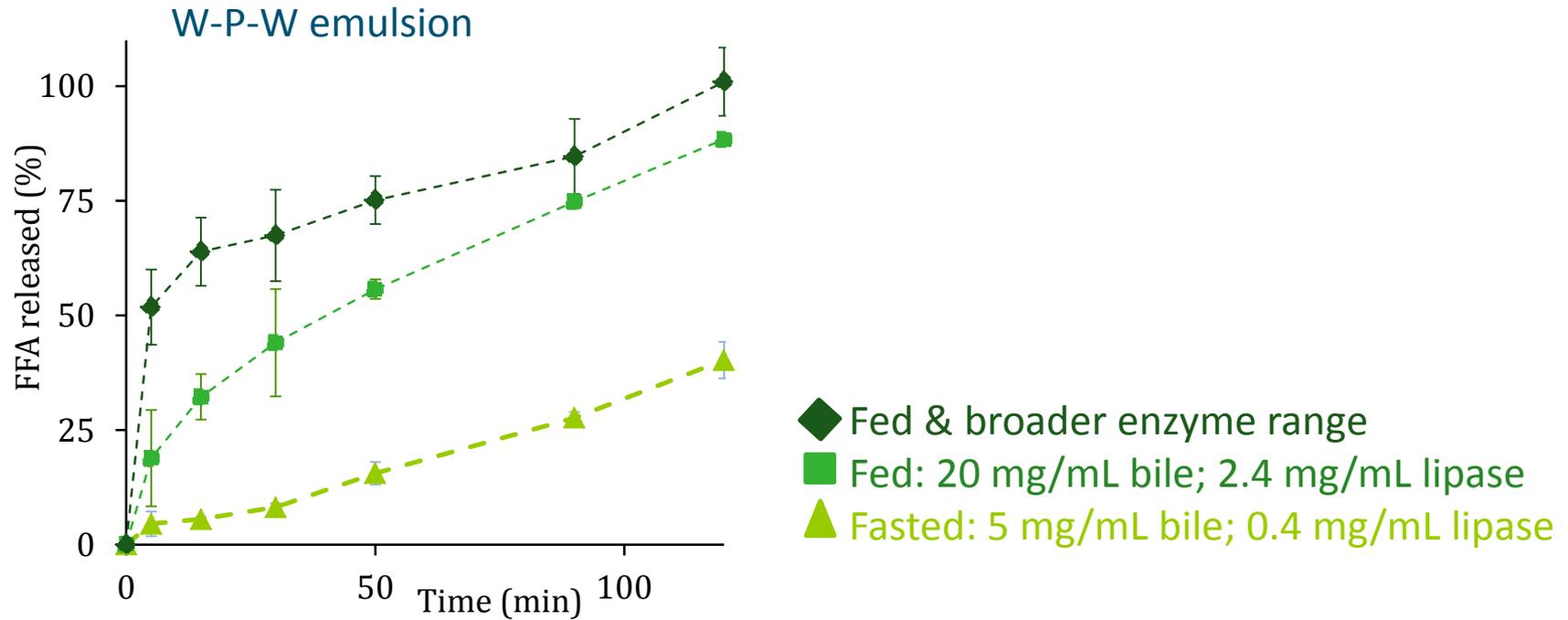
delayed by 2<sup>nd</sup> / 3<sup>rd</sup> layer

0.4 mg/mL lipase | 5 mg/mL bile  
150 mM NaCl | 10 mM CaCl<sub>2</sub>  
pH 7.0 | 2.5 h | 37 °C



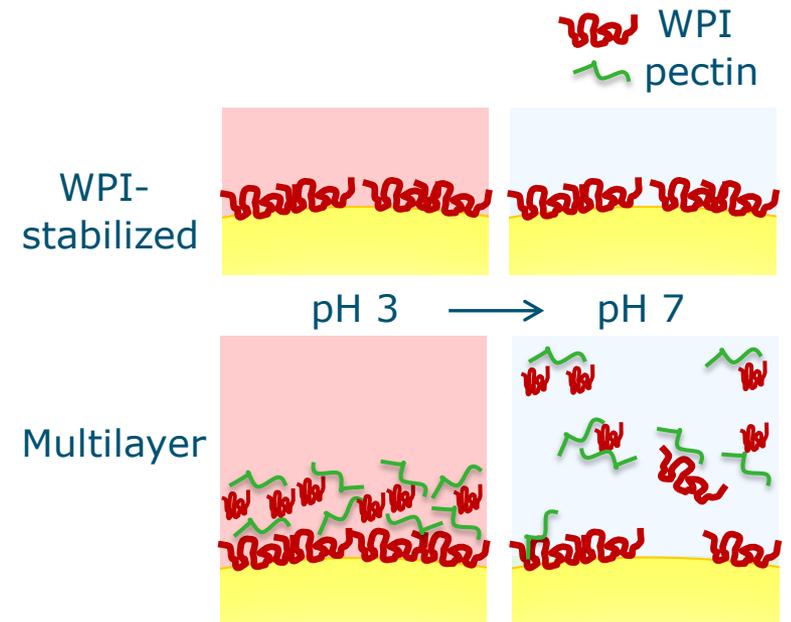
# Harsher *in vitro* intestinal conditions

accelerated lipolysis



# Summary

- Multilayered WPI/pectin emulsion
  - ✓ Layer-by-layer up to 5
  - ✓ pH stability
  - ✓ Gastric stability
  - ✓ Intestinal stability?



# Take home message

- pH range in body limits suitability multilayered interface

- F... – gastric protection

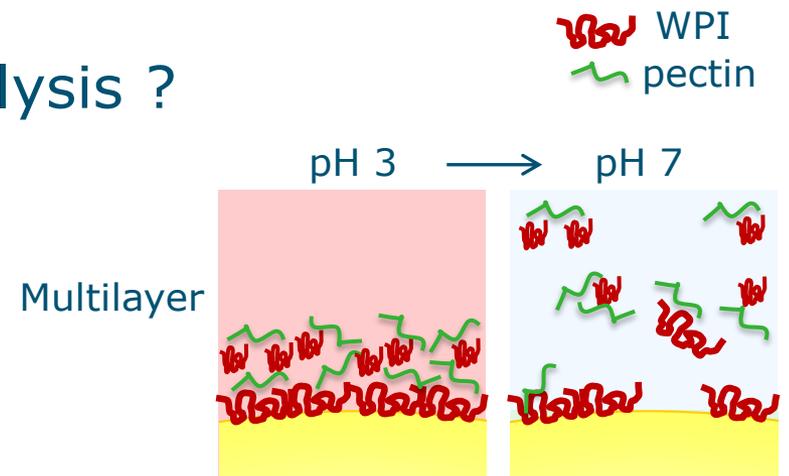
Thank you for your attention!

...al pH in intestine

- ...ut for duodenal brake

- Inc... lipolysis ?

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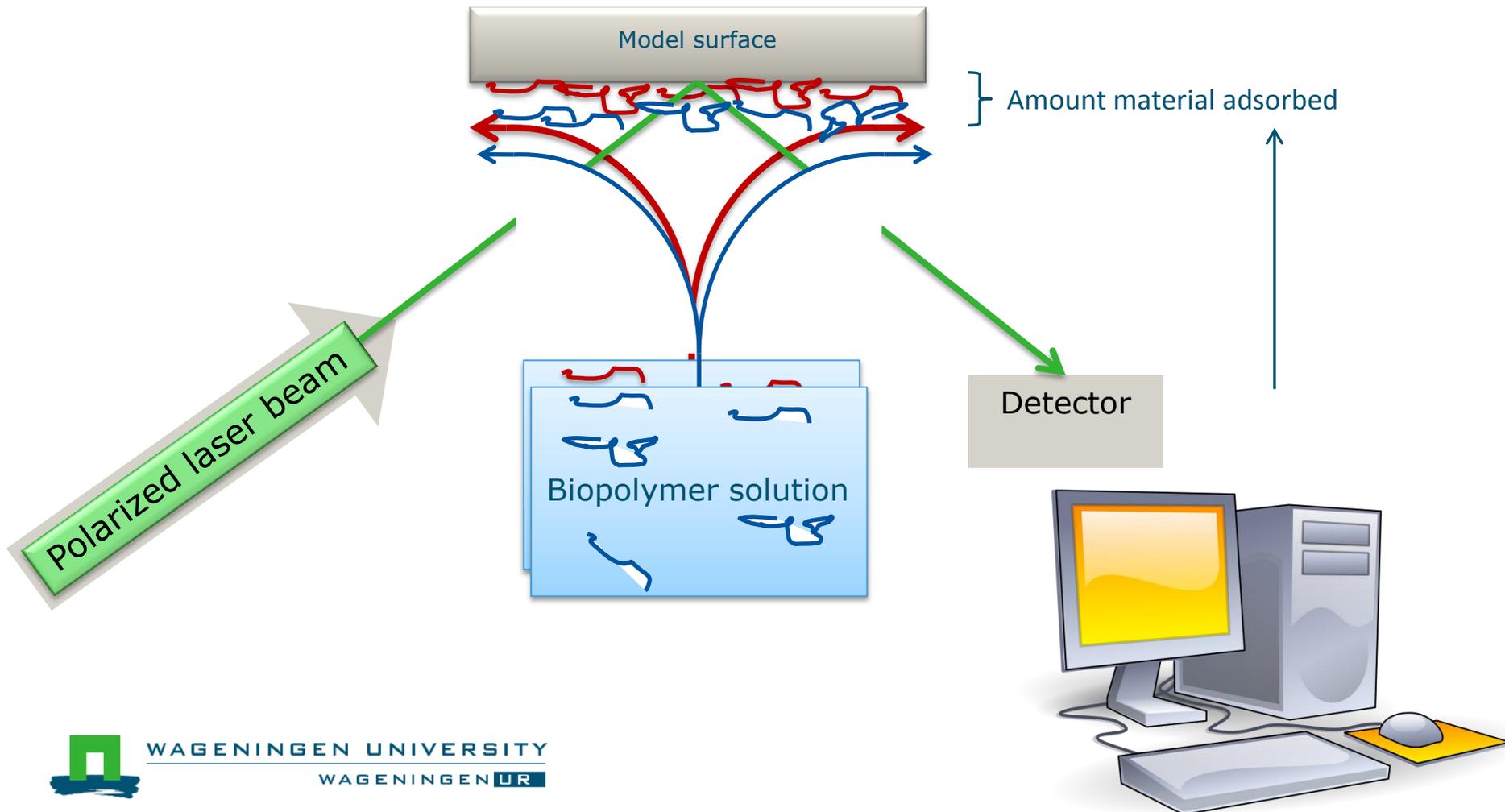


E-mail: [meinou.corstens@wur.nl](mailto:meinou.corstens@wur.nl)

Thank you for your attention!



# Reflectometry – adsorption measurements



# Interface activity of lipase

similar for all emulsions

