

# Towards understanding of the formation of layered and fibrous structures in dense biopolymer blends

*Fibrous structures for meat replacers*



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# Take home message



- Shear-induced structuring of a water-in-water emulsion, consisting of pectin/soy blend, leads to the formation of fibrous structures
  - Pectin = dispersed phase, SPI = continuous phase
- Under shear flow pectin forms elongated droplets, the degree of deformation and hence fibrousness can be tailored with
  - Heating temperature
  - Shearing time
  - Rotational speed

# Fibrous structures

- Interest in making fibrous structures for the application of meat replacers
- Shear-induced structuring with simple shear flow under heating
- Soy protein concentrate (SPC)
  - Soy Protein Isolate (SPI) + Polysaccharides → Pectin

SPC



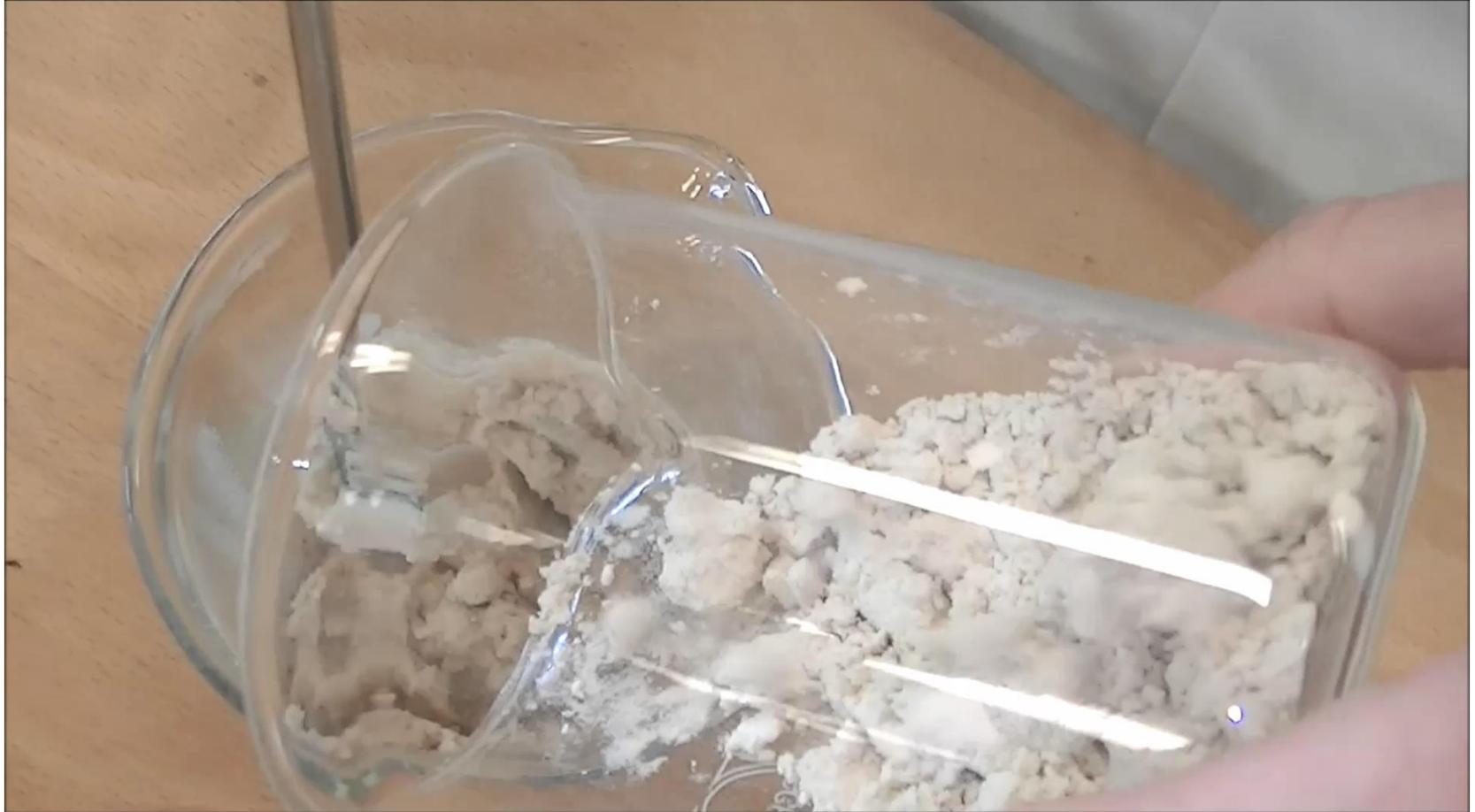
SPI



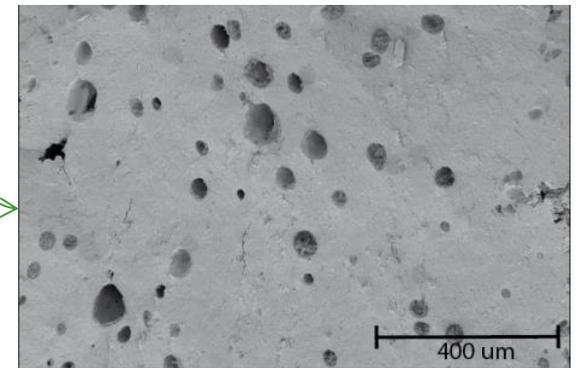
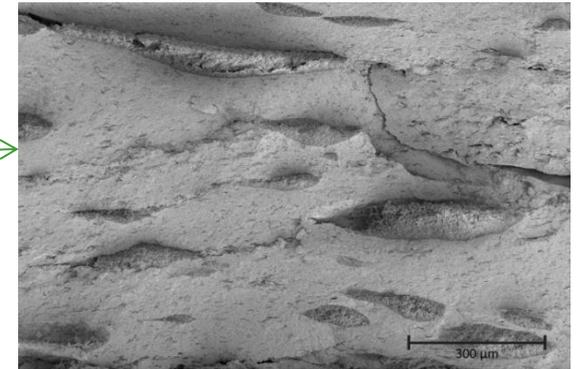
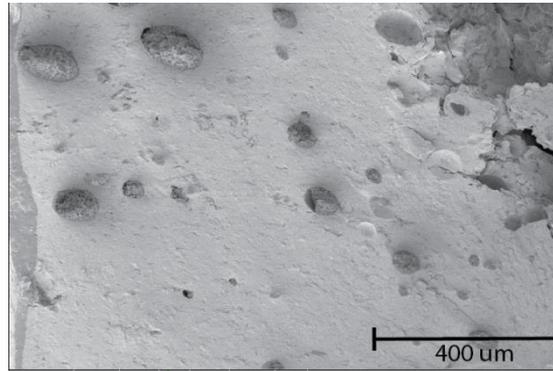
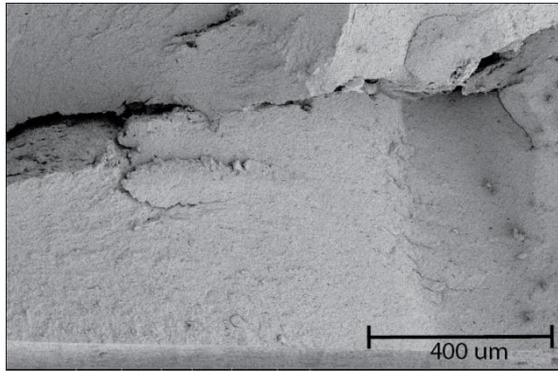
SPI + Pectin



# Movie

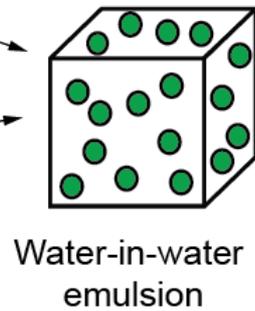


# Microstructure (SEM)

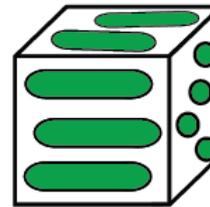


SPI

Pectin



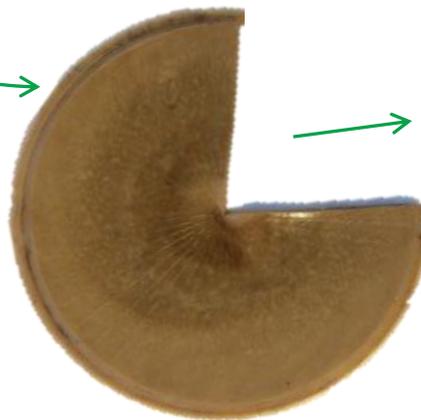
Shear-induced structuring



# Quantification anisotropy

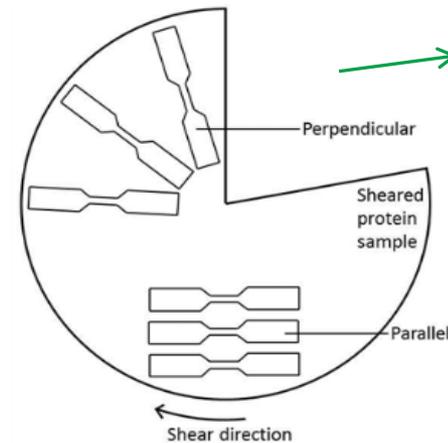
Important process variables for shear-induced structuring

- Heating temperature
- Shearing time
- Shear rate

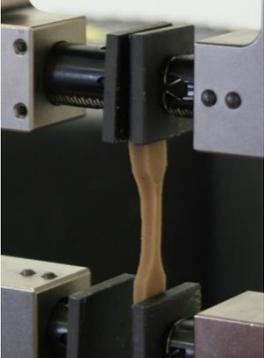


Tensile strength analysis

- Parallel
- Perpendicular

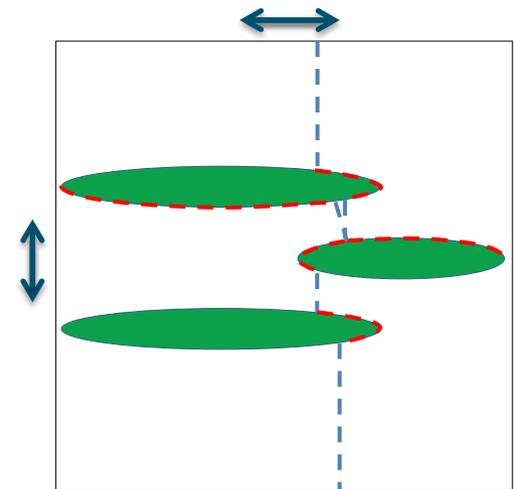
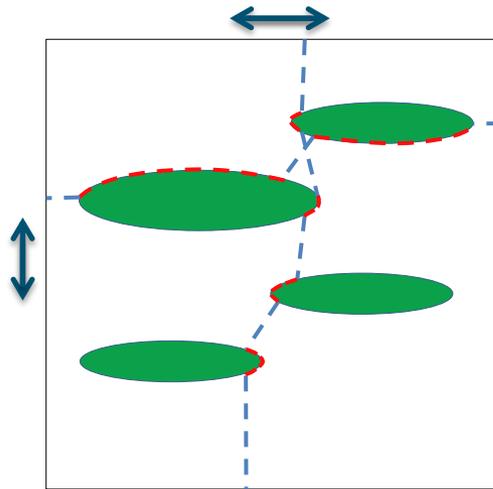
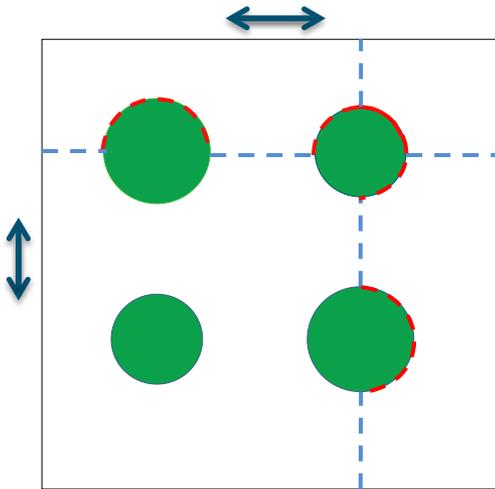
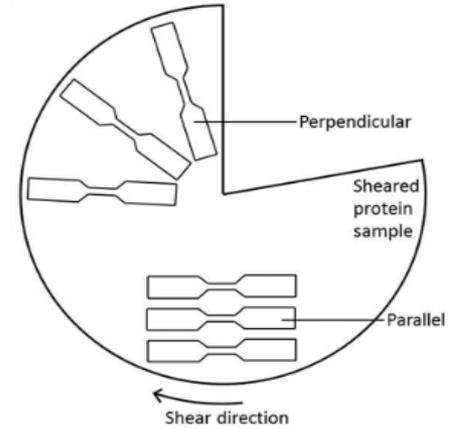


# Tensile strength analysis



## Tensile strength analysis

- Pectin phase *or* interface between pectin/SPI is **soft**



# 1) Temperature

120 °C

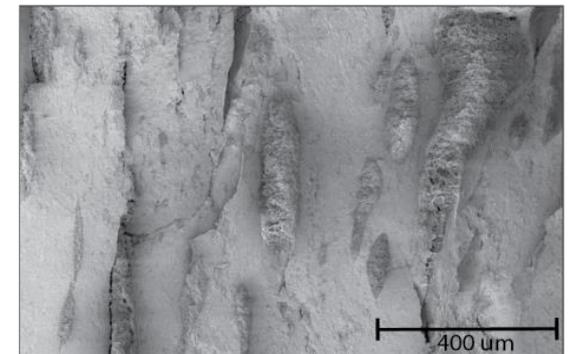
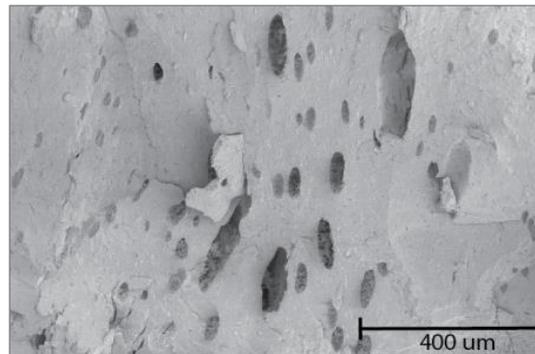
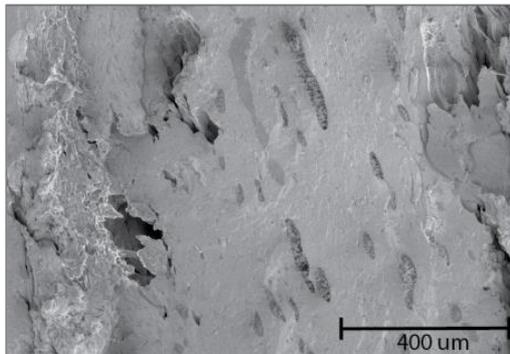
130 °C

140 °C

*Macrostructure*

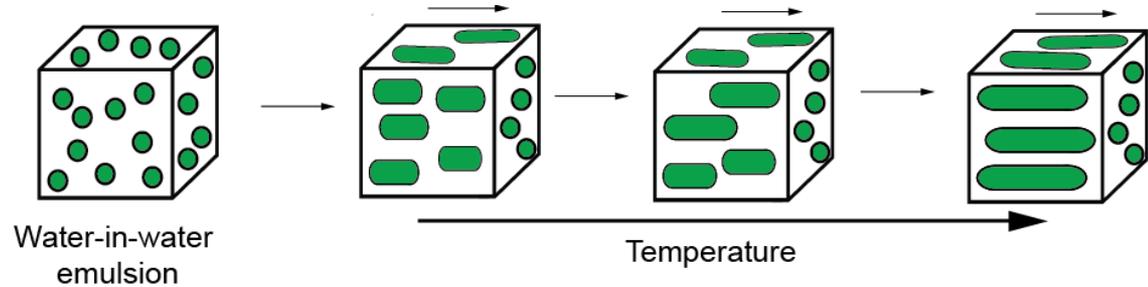


*Microstructure*

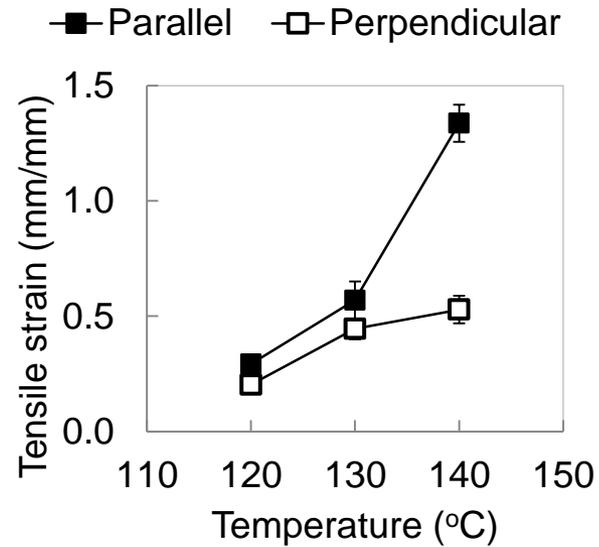
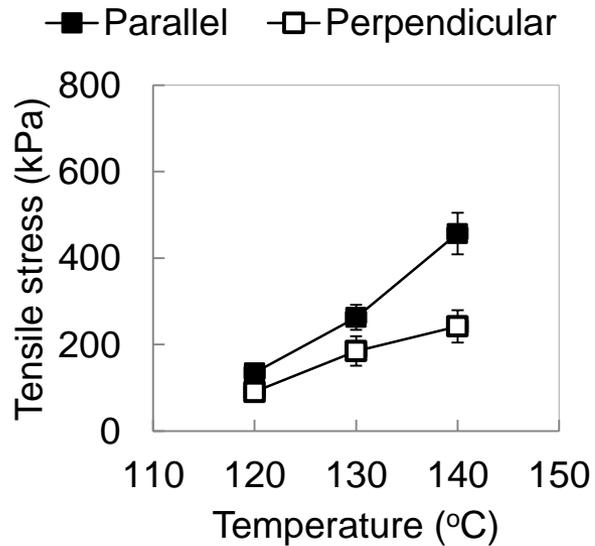


# 1) Temperature

Microstructure



Tensile strength analysis



## 2) Shearing time

3

5

10

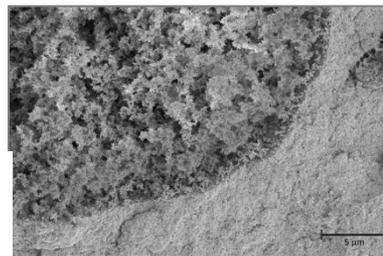
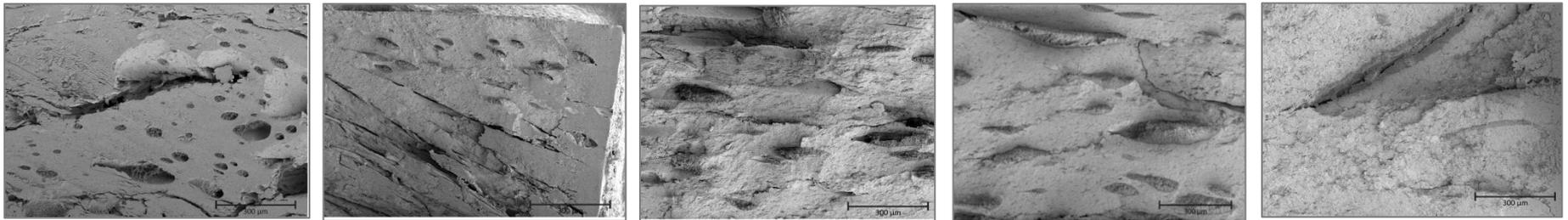
15

30 (min)

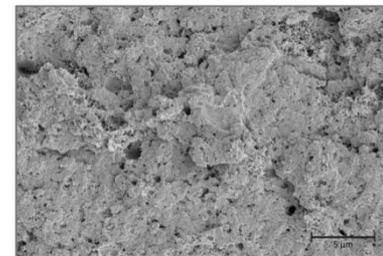
*Macrostructure*



*Microstructure*

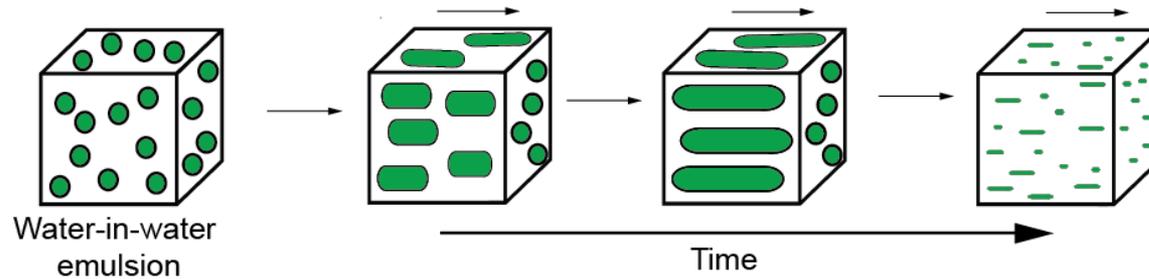


Pectin dispersed  
through the  
continuous soy phase

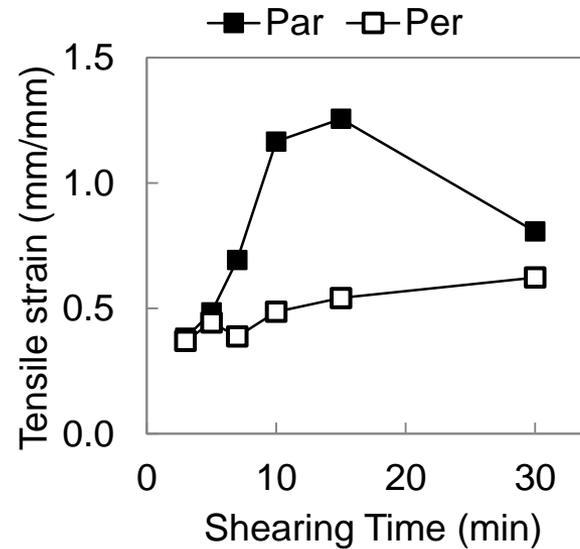
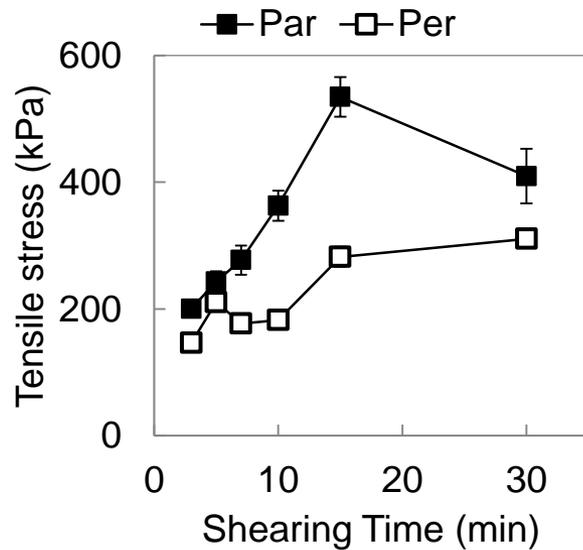


## 2) Shearing time

### Microstructure



### Tensile strength analysis



# 3) Rotational speed

0 RPM

10 RPM

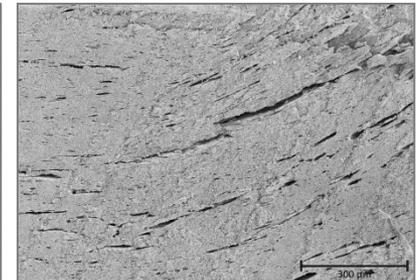
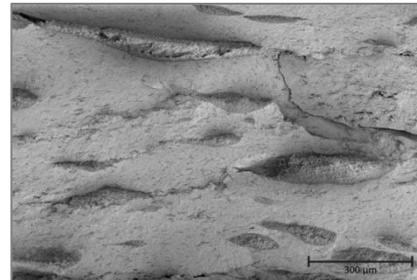
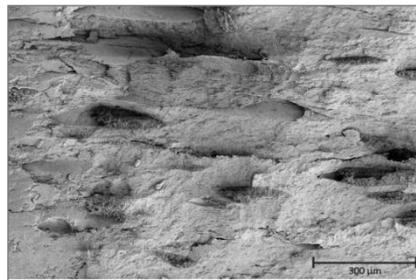
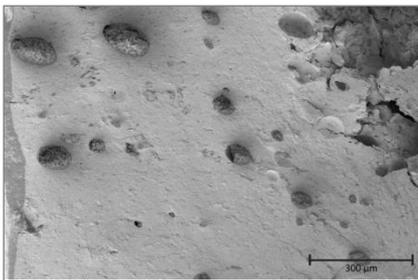
30 RPM

100 RPM

*Macrostructure*



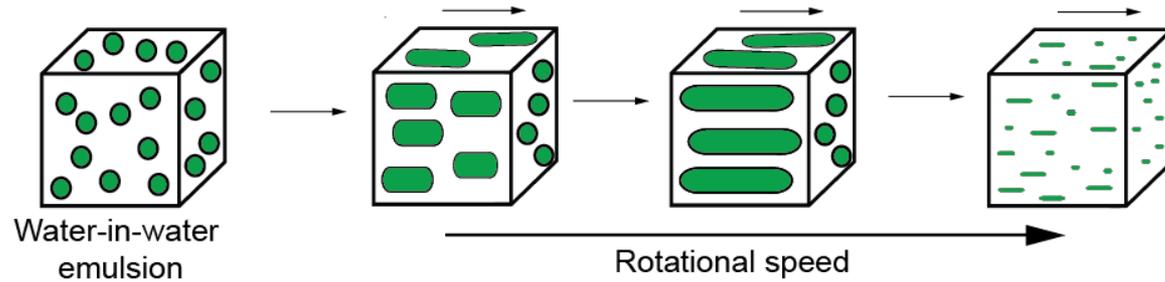
*Microstructure*



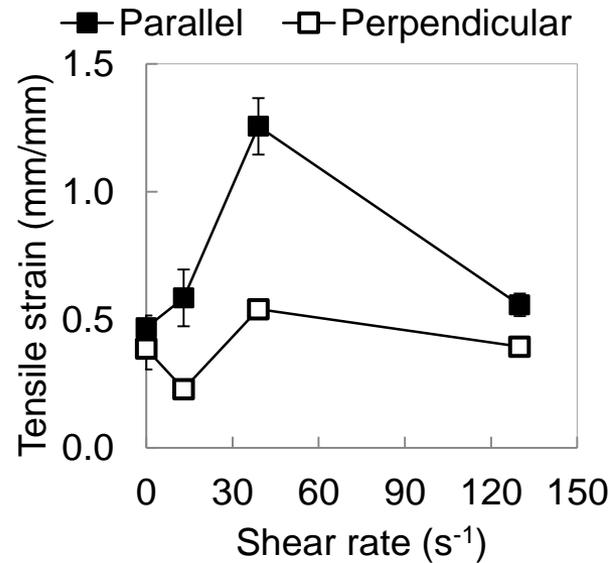
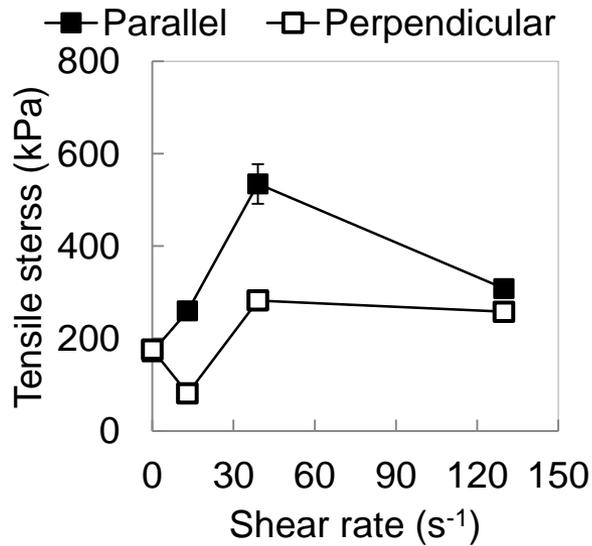
Pectin dispersed  
through the  
continuous soy phase

# 3) Rotational speed

Microstructure



Tensile strength analysis

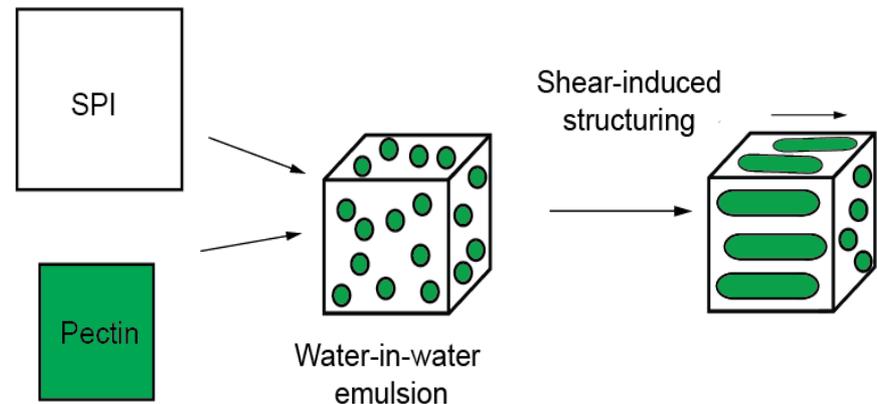


# Conclusion



- Shear-induced structuring of a water-in-water emulsion, consisting of a pectin/soy blend, leads to the formation of fibrous structures
  - Pectin will form the dispersed phase, and SPI the continuous phase.
- Under shear flow pectin forms elongated droplets, the degree of deformation and hence fibrousness can be tailored with

- Heating temperature
- Shearing time
- Rotational speed



Thank you for  
your attention

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