



UHT treatment on the stability of faba bean protein emulsion

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Plant-based milk alternatives

- Plant-based milk alternatives are more environmentally friendly than dairy
- Nut-milks have a higher eco-impact than grain or legume-based milks
- Most common plant-based milk is soy milk
- Health risk associated to soybean e.g. soy allergy

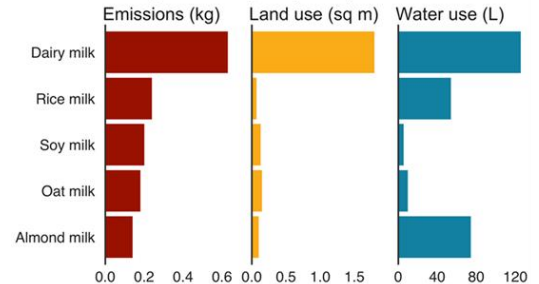



Food Science Challenge:

- Soy protein substitute
- Off (beany, oxidation) flavour
- Watery mouthfeel
- Colloidal instability over shelf life
- Nutritional benefits (eg phenols)
- Mineral fortification
- Presence of anti-nutritionals and allergens

Which milk should I choose?

Environmental impact of one glass (200ml) of different milks

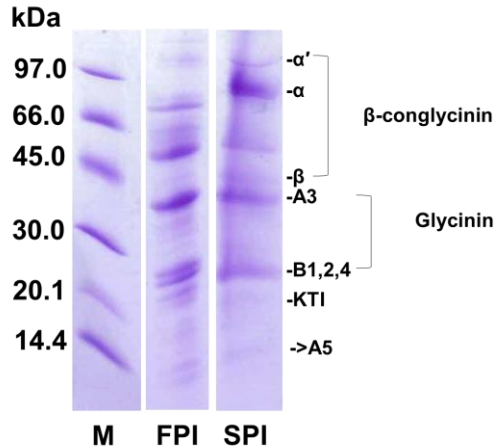


Source: Poore & Nemecek (2018), Science. Additional calculations, J. Poore 

Faba beans protein has a huge potential
due to higher protein contents and less anti-nutritional components



Faba bean protein



M = LMW marker

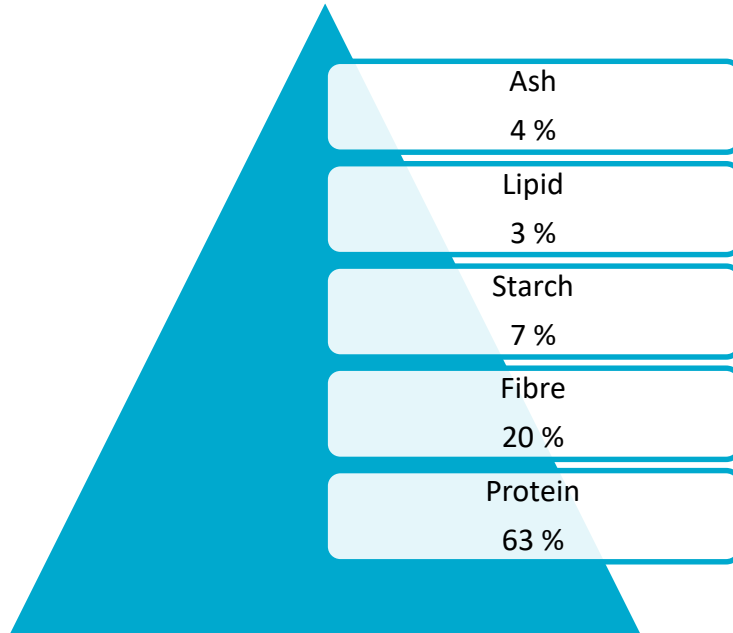
FPI = Faba bean protein isolate ~ < 85 % protein

SPI = Soy protein isolate ~ 83 % protein

Faba bean protein bands are similar to soy, showing it's potential to be used soy protein alternative in legume based beverages



Model faba protein-based beverage with high protein (5-8 %) and functional components



Faba bean concentrate used in this study



Experimental design



Faba bean protein concentrate

Multi-mixing at 1000 rpm
for 10 min

5 mM K_3PO_4 buffer, pH 8
Sunflower oil, 1 %
Sunflower lecithin, 0.2 %

Dissolution of protein in buffer

Emulsification by using
multi-mixing at 10000 rpm
for 20 min

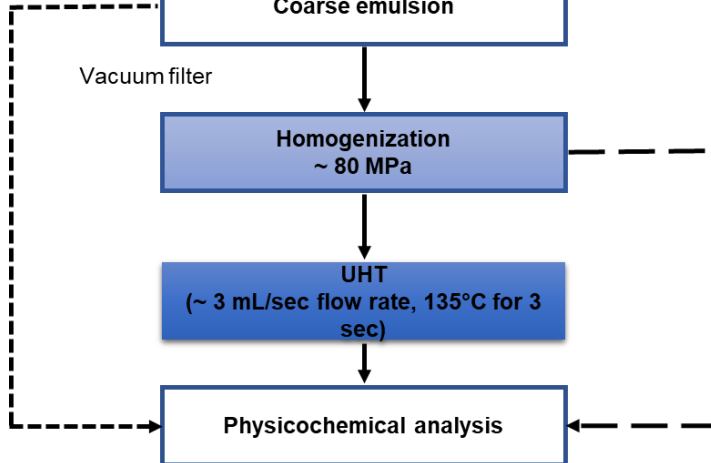
Coarse emulsion

Vacuum filter

**Homogenization
~ 80 MPa**

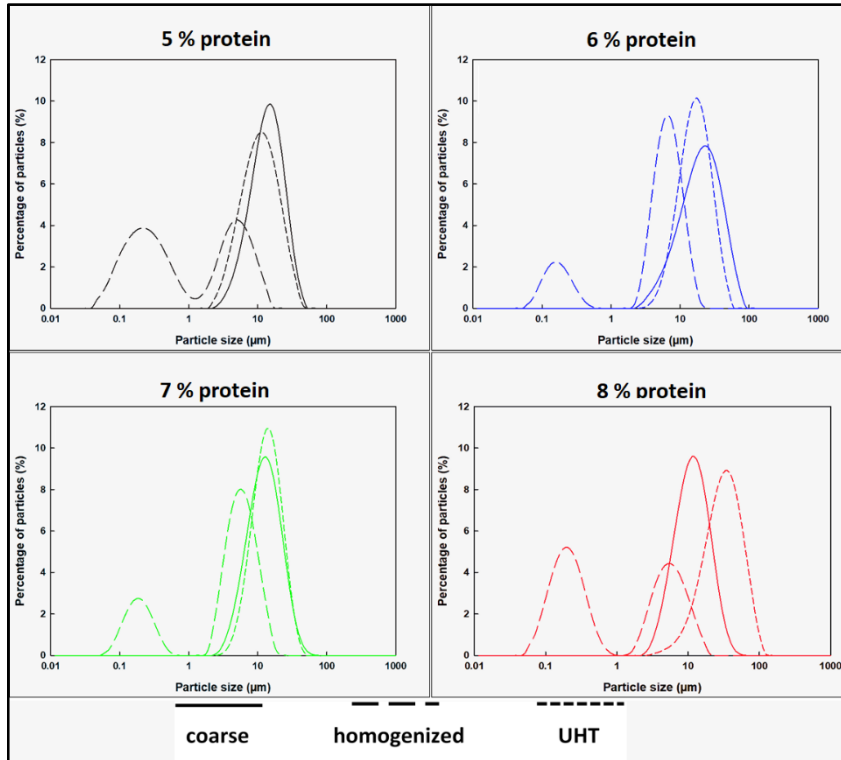
**UHT
(~ 3 mL/sec flow rate, 135°C for 3
sec)**

Physicochemical analysis





Particle size distribution

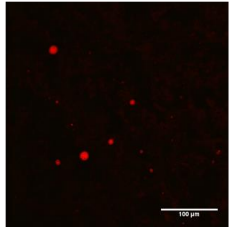


UHT resulted in bigger size particles possibly due flocculation and coalescence

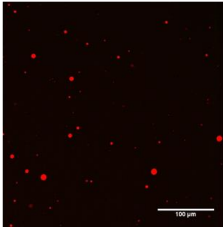


Confocal micrographs

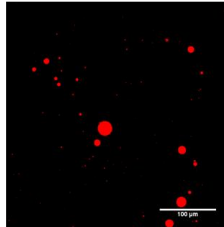
5 % protein



coarse

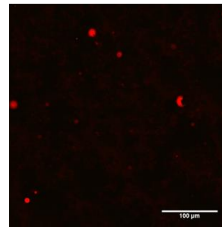


homogenized

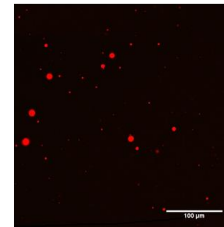


UHT

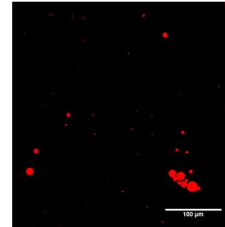
6 % protein



coarse

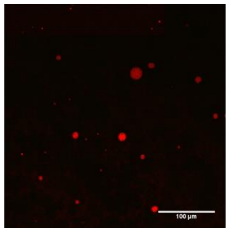


homogenized

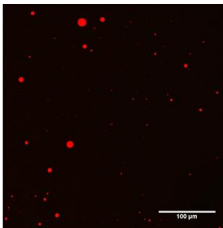


UHT

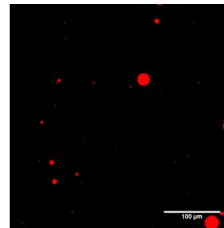
7 % protein



coarse

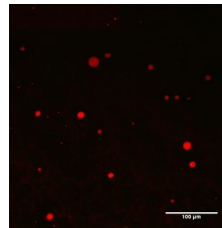


homogenized

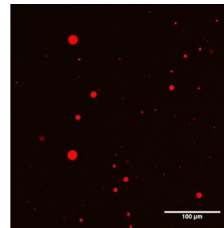


UHT

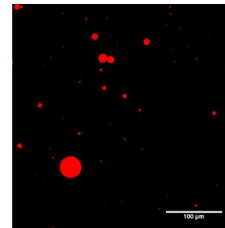
8 % protein



coarse

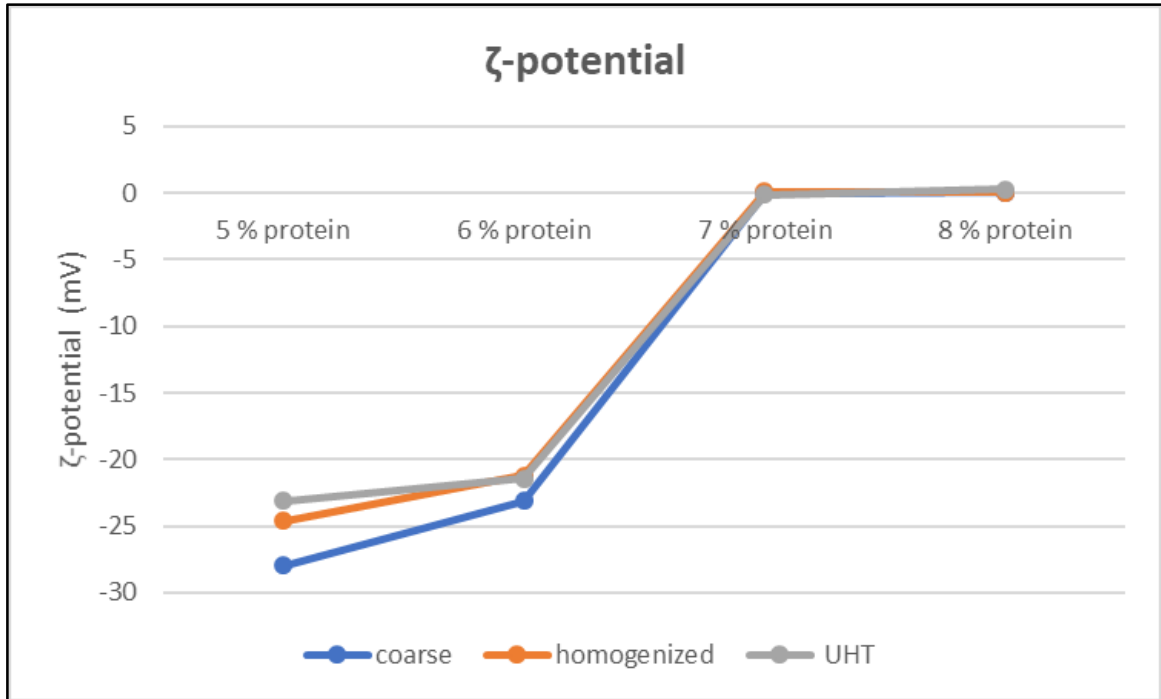


homogenized



UHT

ζ -potential



ζ -potential is an indication of emulsion stability. Emulsions 7 and 8 % protein easily flocculate or coagulate due to ζ -potential value near 0.



Thermal induced gelation



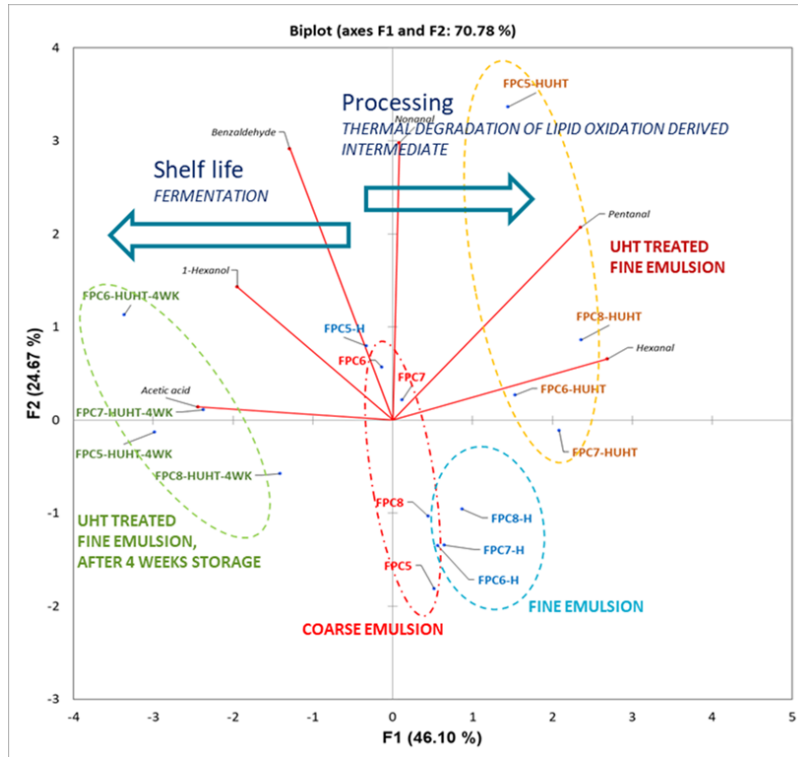
Fresh UHT



UHT (24 hour storage at 4°C)

Thermal induced gelation occurred in shelf stable beverage samples possibly due to protein denaturation and unfolding hydrophobic chains

Off-flavours of model drink



In total 21 compounds were detected and quantified, representing different chemical classes such as alcohols, aldehydes, ketones, esters, furan and acids.



Thank you

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Conclusions

- Faba bean has similar protein like soybean and can be used as soy replica in plant-based milk alternatives.
- Protein emulsions with 8 % protein showed induced gelation after UHT. Therefore, further research is planned to overcome this challenge.