BRIDGE2FOOD EUROPE

The Hague (The Netherlands), 3-5 June 2025

Legume concentrates, their techno-functionalities and impact of processing

Sofie De Man

ILVO Instituut voor Landbouw-, Visserij- en Voedingsonderzoek

ALEHOOP

FOOD PILOT

Flanders is agriculture and fisheries

Who is ILVO?

ILVO

Flanders Research Institute for Agriculture, Fisheries and Food

Research Center of the Flemish Government

Mission: to make the agriculture, fisheries and agri-food sectors more sustainable.

In Flanders, Belgium, Europe and the rest of the world.

For which sector?

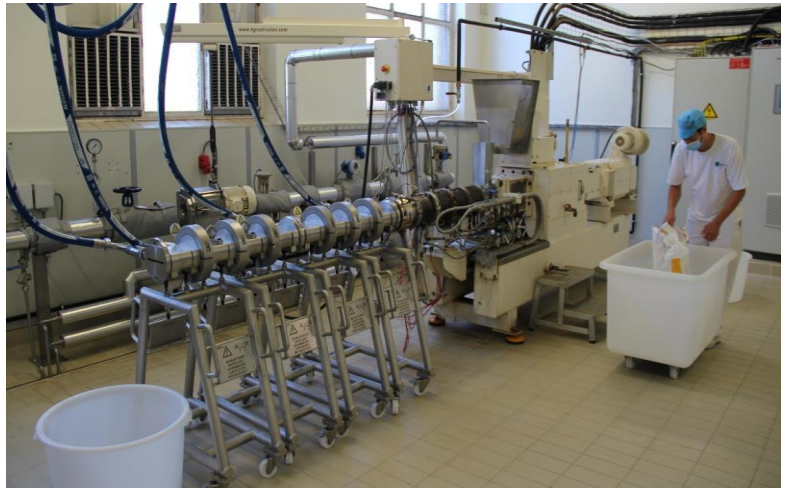
Our infrastructure

- 10 sites in Merelbeke, Melle, and Ostend
- 220 ha trial fields
- 50 ha organic in agro-ecologisch platform
- Experimental greenhouses
- Experimental- and educational animal housing (dairy, pigs, poultry)
- 40 specialized labs
- Pilot plants for food and feed
- Specialized research facilities

FOOD PILOT

Pilots

FOOD PILOT



FEED PILOT

POST HARVEST PILOT

Food Pilot – lab analysis - advise

>100 Processing machines

>500 Trials a year

Fractionation – Filtration – Pasteurization – Sterilization – Evaporation – Drying – Milling – Mixing and Homogenization – Incubating – Shaping – coating – Aerating – Packiging

100 Food Experts

- Ingredients
- Dairy (analogues)
- Meat (analogues)
- Feed
- Snacks, Chocolate, Bakery, …

6 Food labs

>20.000 Analyses a year in accredited food labs

Functio-nality

Micro-biology

Taste & Odor

GMO & Allergens

Toxins

Nutrition

Research themes

Embedded within research organization: ILVO

Flanders Research Institute for Agriculture, Fisheries and Food

- Common purpose
- Private purpose

Themes in food research

- Novel food
- Side stream valorization
- Protein diversification
- Ingredient functionality
- End product quality: shelf-life, taste, texture, toxins,…
- LCA

www.FoodPilot.be

FLANDERS' FOOD ILVO FOOD PILOT

Our DNA?

ILVO +

- Universities and University Colleges
- VIB, IMEC, VLIZ, VITO
- Practical research centers
- ...

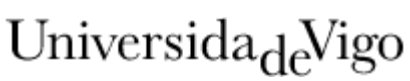
European partnerships: 80 EU projects submitted in 2024

HORIZON EUROPE

Interreg

WORKING TOGETHER

These results



Introduction

- Exponential interest in plant proteins
  - increasing awareness risk of some diseases
  - high impact on the environment + long-term affordability
- Soy is the most popular
  - High content essential amino-acids
  - Good functionality and digestibility
- Legumes seeds are gaining interest
  - High protein and fibre content
  - Prescence some essential amino-acids
  - However: Antinutritional factors

Experimental set-up

Start material

Extraction

AE – IEP

Drying

Freeze drying
pH 5 + milling

Spray drying
pH 7

Functionality

Foaming capacity

Emulsion capacity

Solubility

Water and oil holding capacity

Experimental set-up

Start material | Extraction | Drying | Functionality

Reference: Soy protein concentrate
- Commercial powder
- 67% protein

Lentil
- 20,03% protein

Lupine
- 32,15% protein

Peas
- 22,51% protein

Beans
- 19,5% protein

Grinded to a coarse powder

Lentil
- 45 w% < 500µm

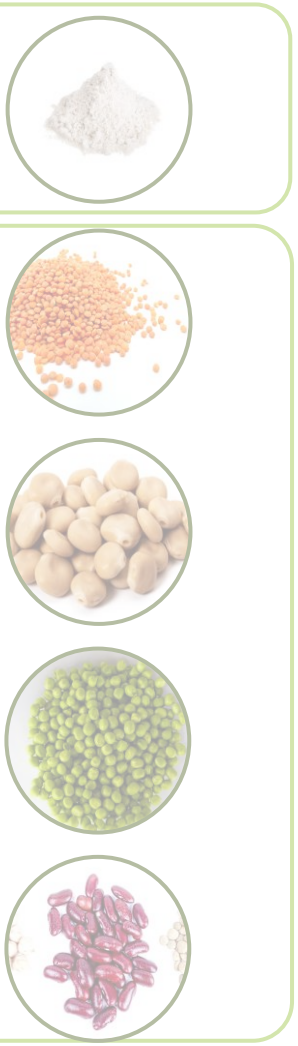
Lupine
- 25 w% < 500µm

Peas
- 50 w% < 500µm

Beans
- 51 w% < 500µm

Experimental set-up

Start material | **Extraction** | Drying | Functionality

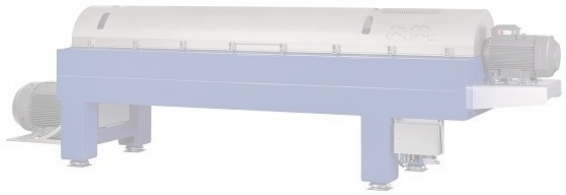


AE - IEP

Experimental set-up

Start material | Extraction | **Drying** | Functionality

AE – IEP



Freeze drying
pH 5 + milling

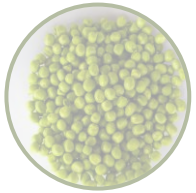
- Low temperatures
- Less input chemicals
- Expensive

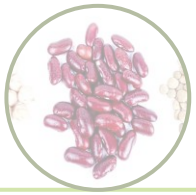
Spray drying
pH 7

- High temperatures
- More input chemicals
- Less expensive

Experimental set-up

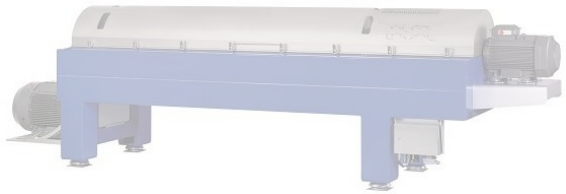
Start material





Extraction

AE – IEP



Drying

Freeze drying
pH 5 + milling

Spray drying
pH 7

Functionality

Soy - Ref
67% protein

Lentil - FD
77,45% protein
3,33% MC

Lupin - FD
73,99% protein
1,72% MC

Pea - FD
80,80% protein
3,77% MC

Bean - FD
64,5% protein
3,60% MC

Lupine - SD
70,53% protein
3,10% MC

Composition and antinutritional factors

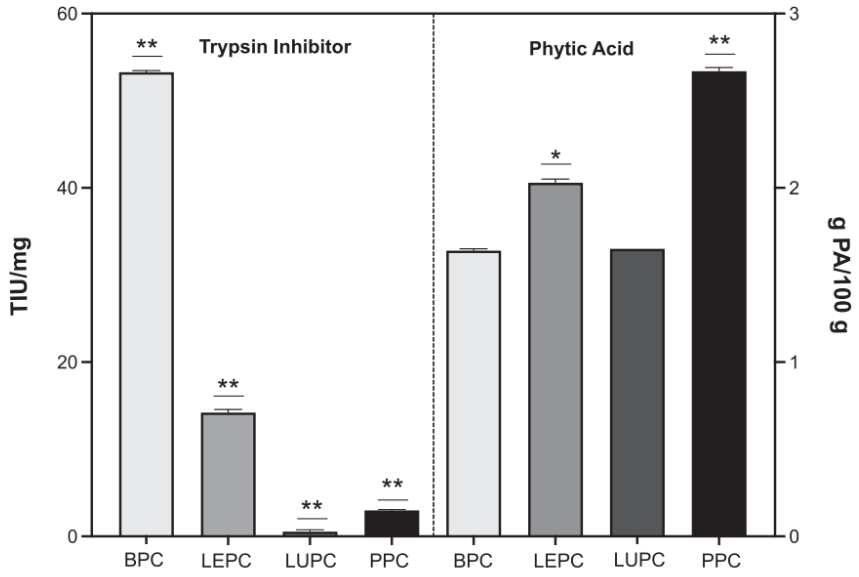
Bean - FD

Lentil - FD

Lupin - FD

Pea - FD

	BPC			LEPC			LUPC			PPC		
IAA	mg/g	% Total AA	AAS %	mg/g	% Total AA	AAS %	mg/g	% Total AA	AAS %	mg/g	% Total AA	AAS %
Total, IAA	475.1	44.4		494.2	43.1		413.0	39.1		516.0	45.2	
Total, DAA	616.2	57.6		653.7	56.9		642.9	60.9		624.9	54.7	
Total, SAA ¥	27.4	2.5	171.8	21.4	1.9	126.8	25.4	2.4	151.2	28.5	2.5	165.5
Total, AAA †	94.4	8.83	294.1	83.48	7.27	254.1	70.92	6.72	209.6	87.06	7.63	262.1
Total, BCAA ‡	210	19.6		220.4	19.2		187.2	17.7		226.7	19.9	



Jiménez-González et al. (2025)

Composition and antinutritional factors

Bean - FD

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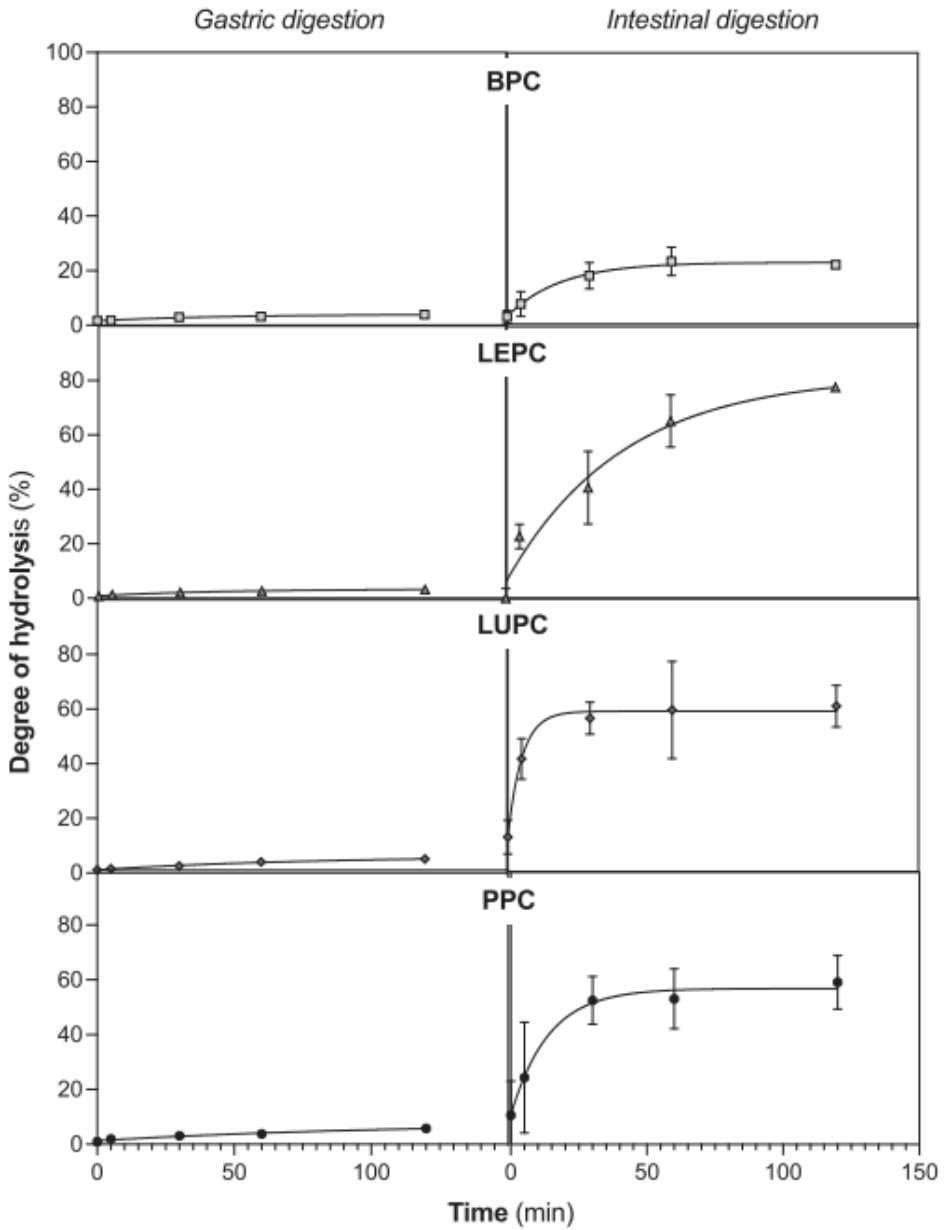

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Experimental set-up

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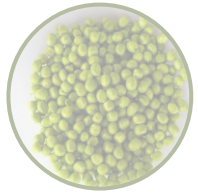

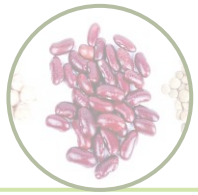

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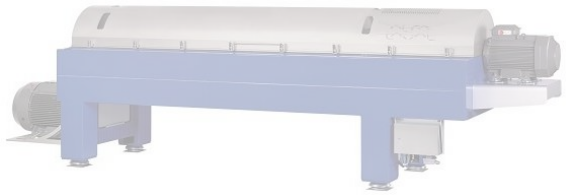
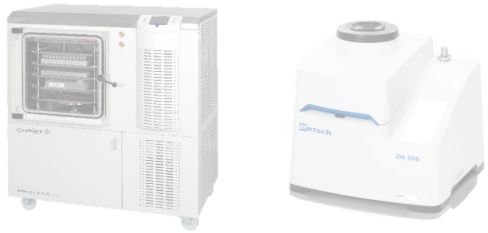


Drying

Freeze drying
pH 5 + milling



Spray drying
pH 7

Functionality

Foaming capacity

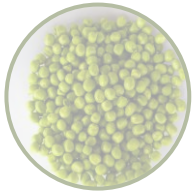
Emulsion capacity

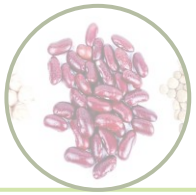
Solubility

Water and oil holding capacity

Experimental set-up

Start material





Extraction

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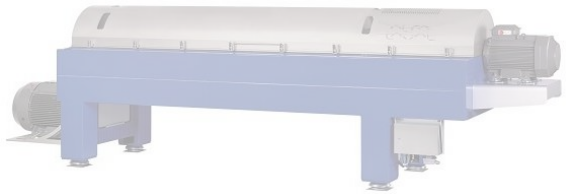

Drying

Freeze drying
pH 5 + milling

Spray drying
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Functionality

Soy - Ref
67% protein

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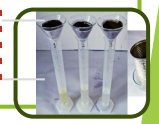
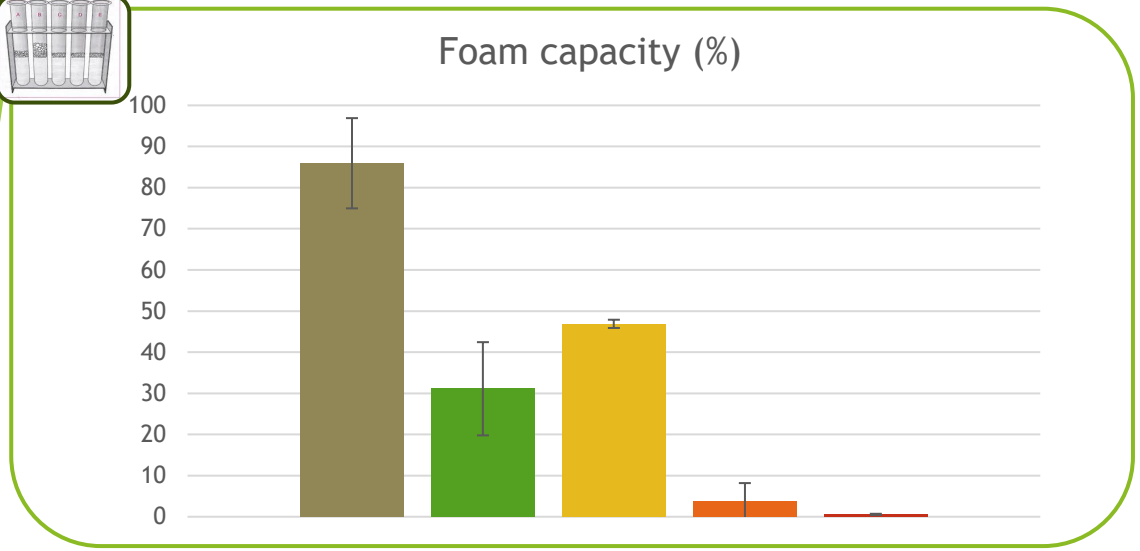
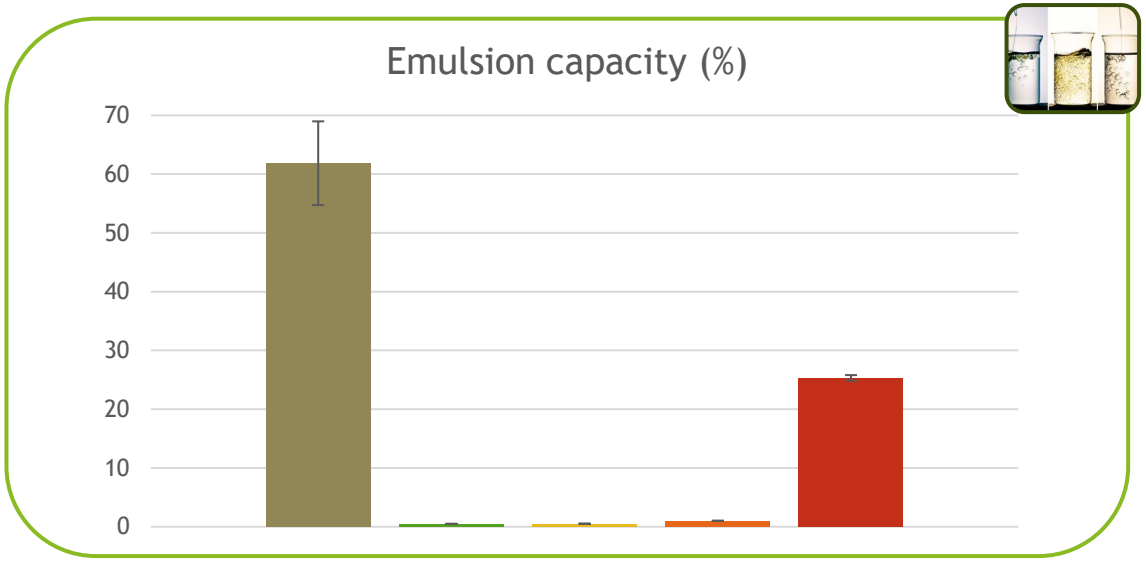
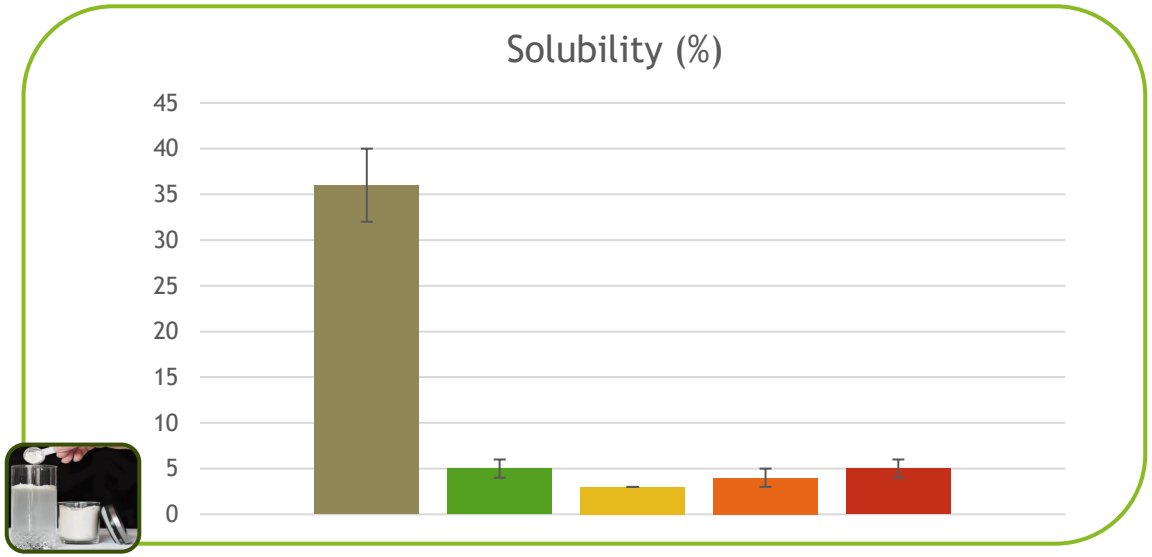
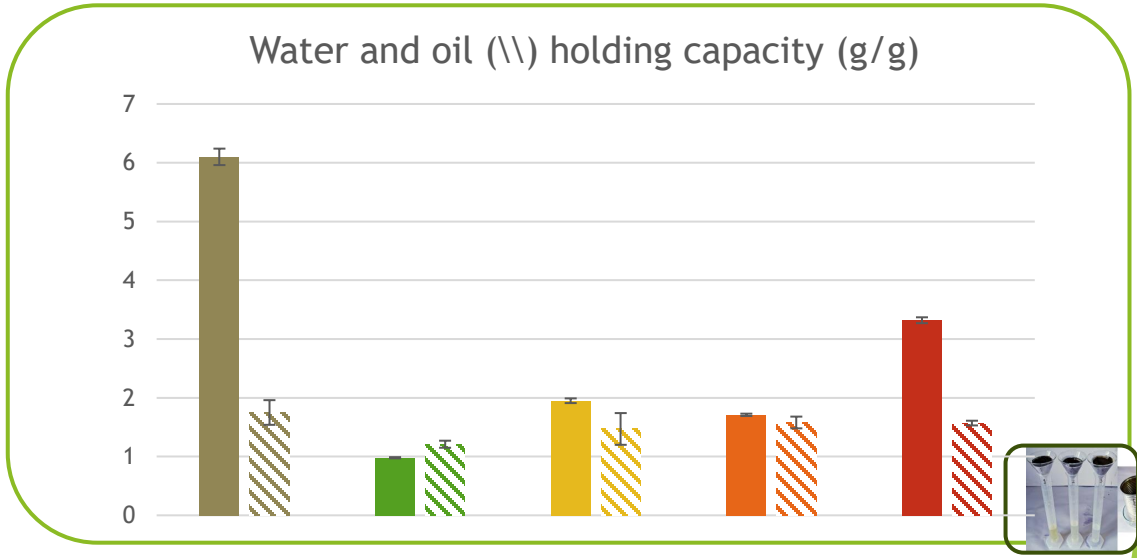
Results - Techno-functionality of legume concentrates





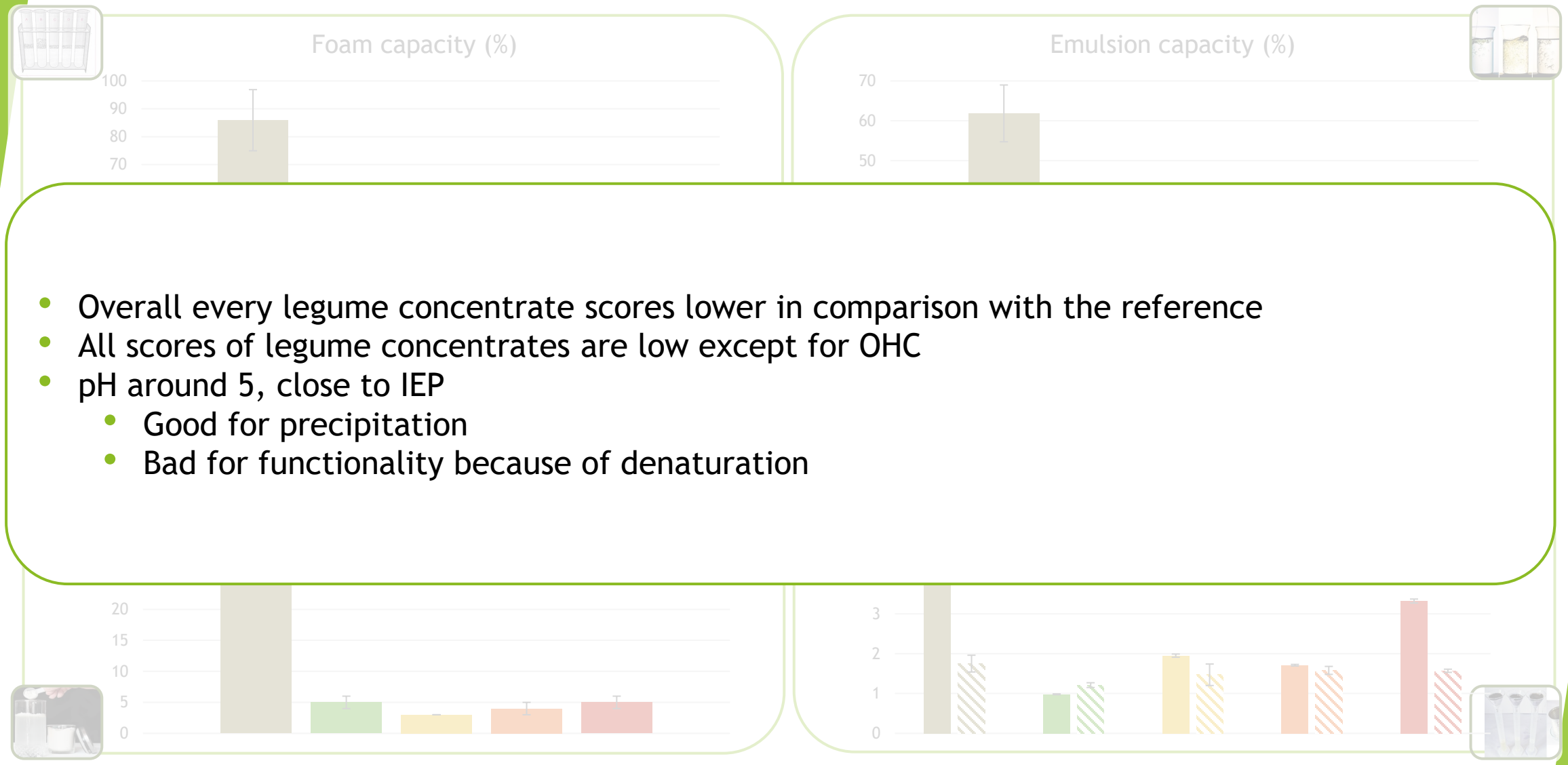






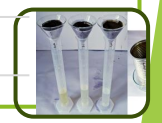
Soy Lupine Pea Lentil Bean

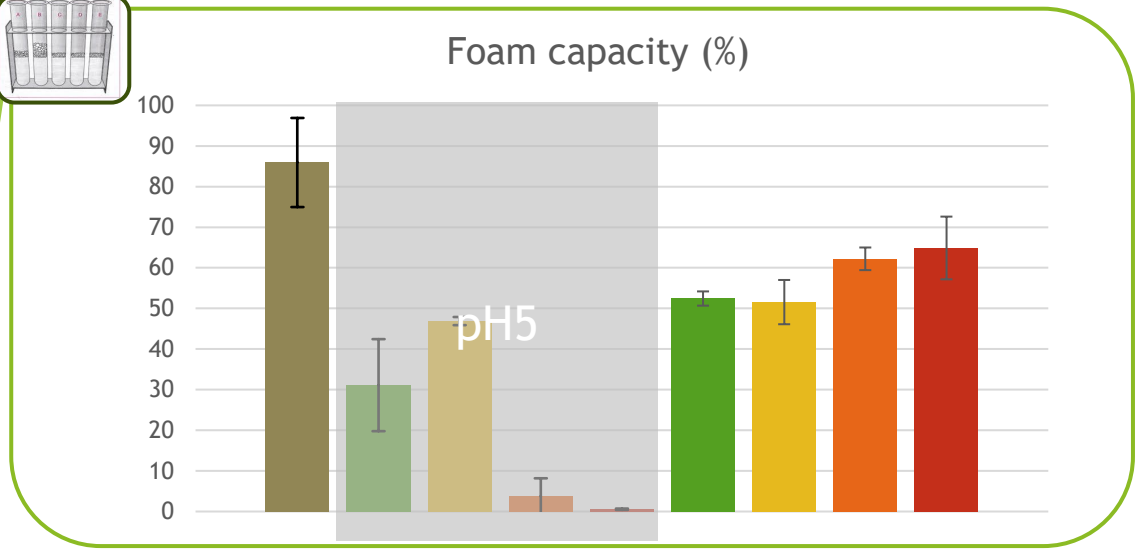
Results - Techno-functionality of legume concentrates

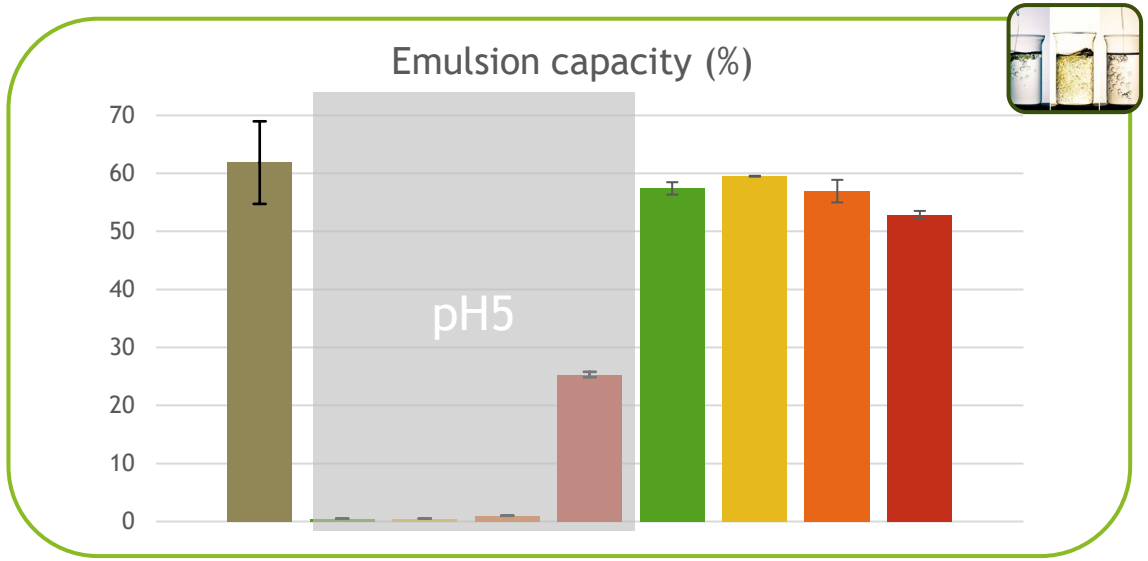


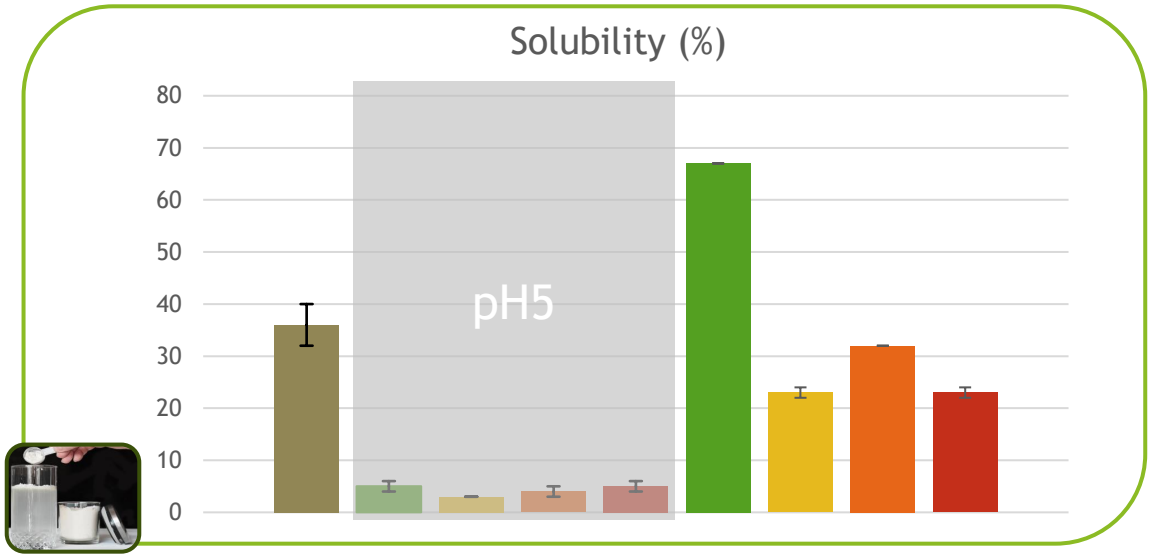
- Overall every legume concentrate scores lower in comparison with the reference
- All scores of legume concentrates are low except for OHC
- pH around 5, close to IEP
  - Good for precipitation
  - Bad for functionality because of denaturation

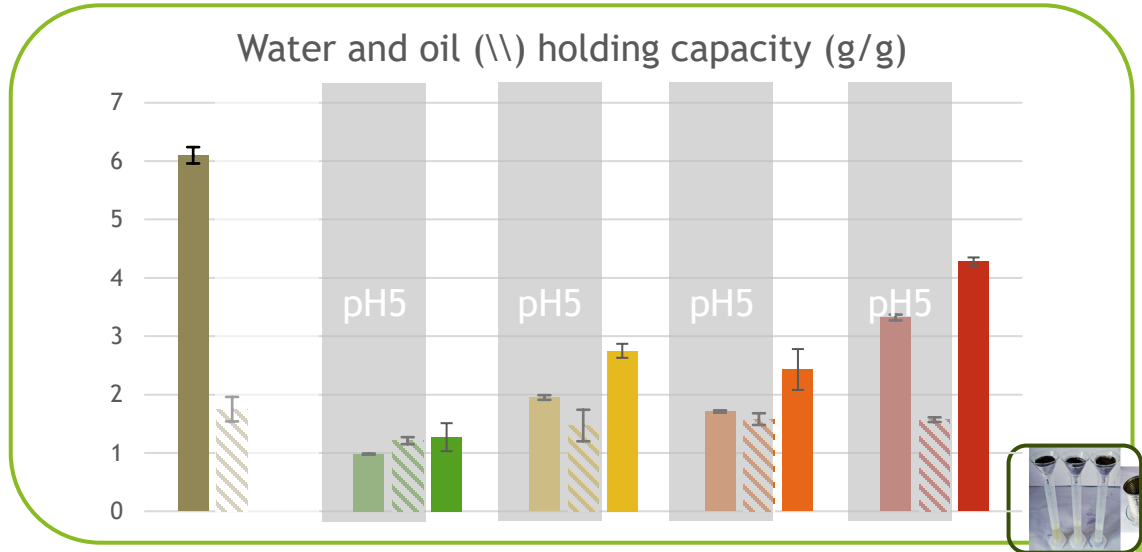
Results - Techno-functionality of legume concentrates altered pH7





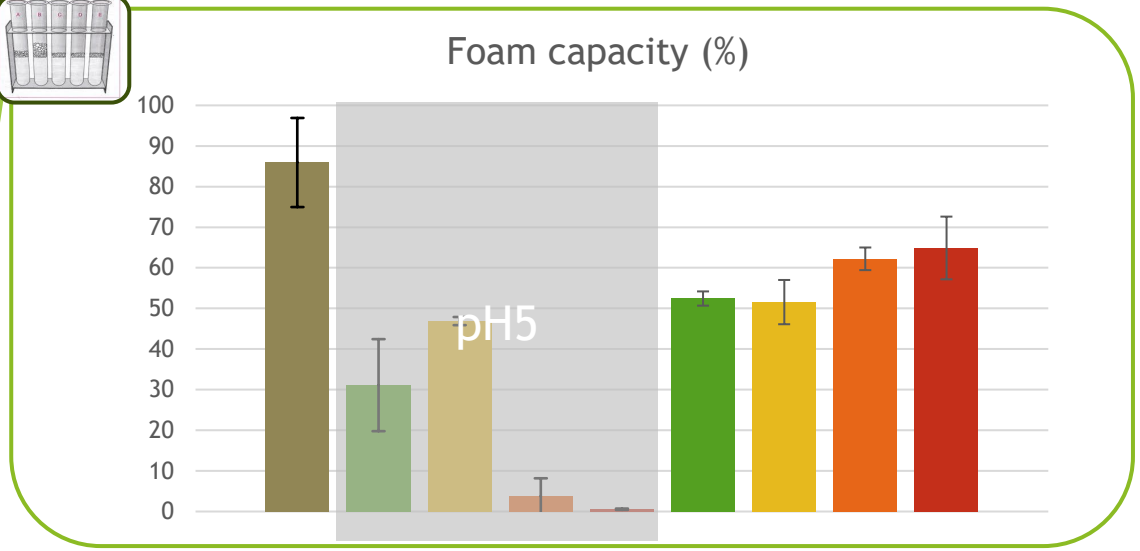


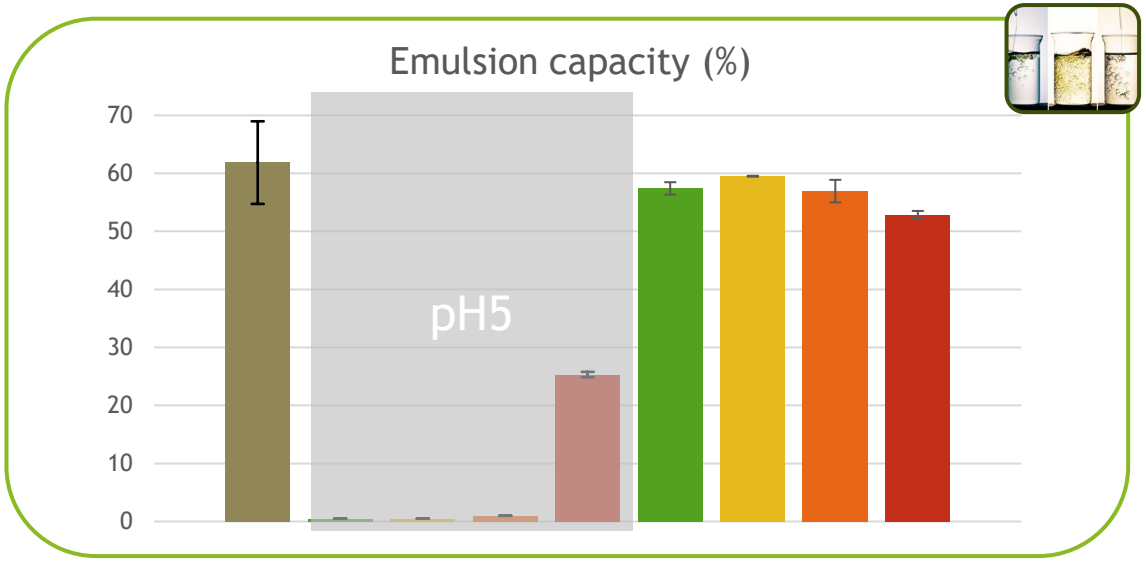




Soy Lupine Pea Lentil Bean

Results - Techno-functionality of legume concentrates altered pH7



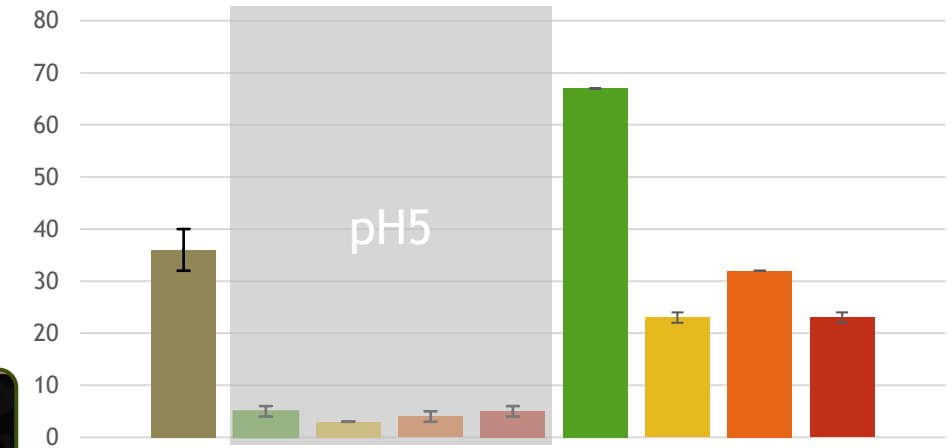


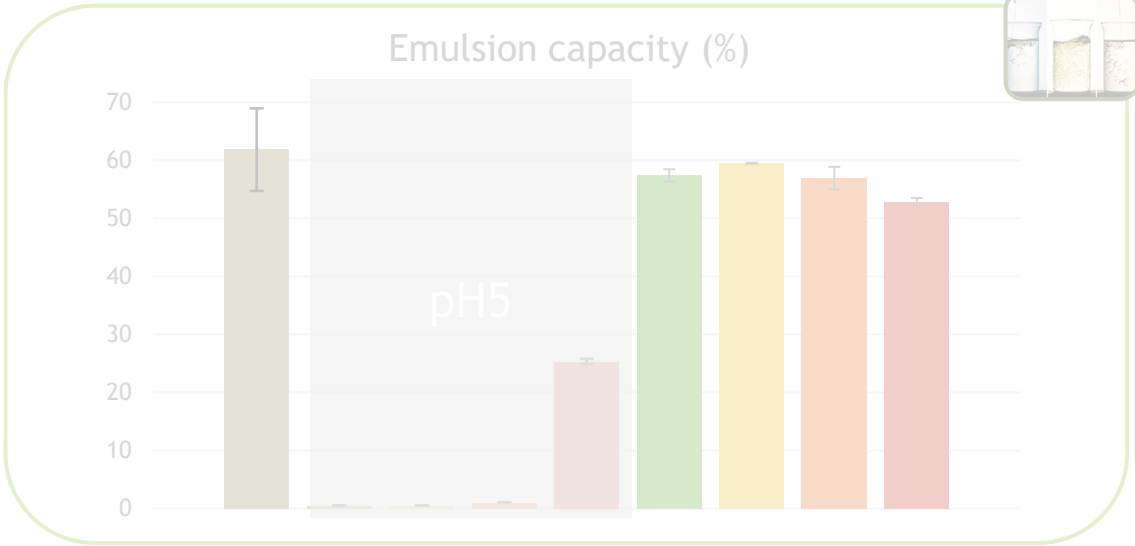
- High increase in foam and emulsion capacity for all legumes
  - Especially good results for emulsion capacity
    - In the range of reference

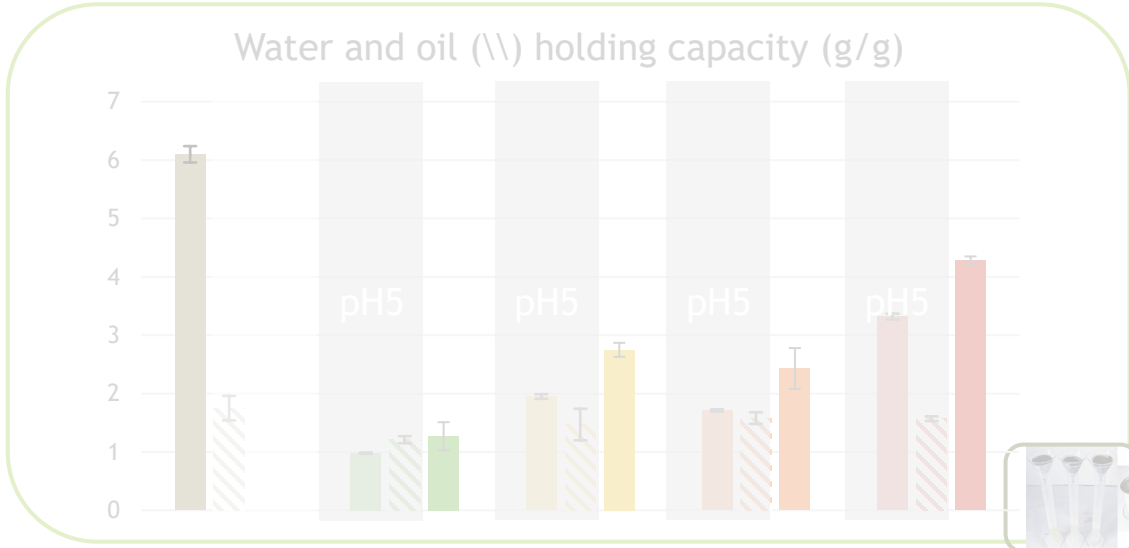
Soy Lupine Pea Lentil Bean

Results - Techno-functionality of legume concentrates altered pH7

- Increase in solubility for all legumes
  - Especially high results for lupine
    - Higer than reference



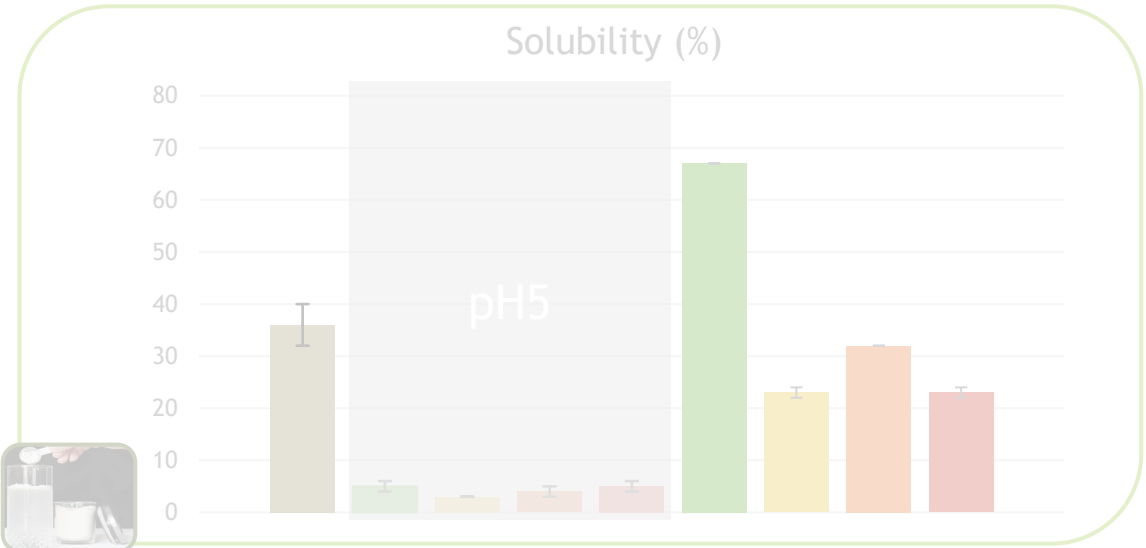


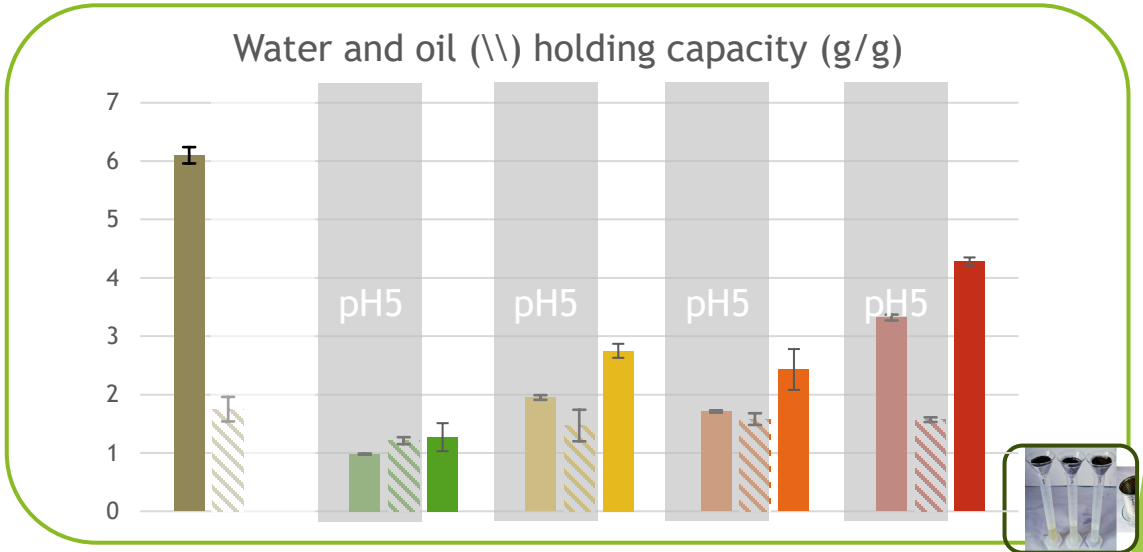


Soy Lupine Pea Lentil Bean

Results - Techno-functionality of legume concentrates altered pH7

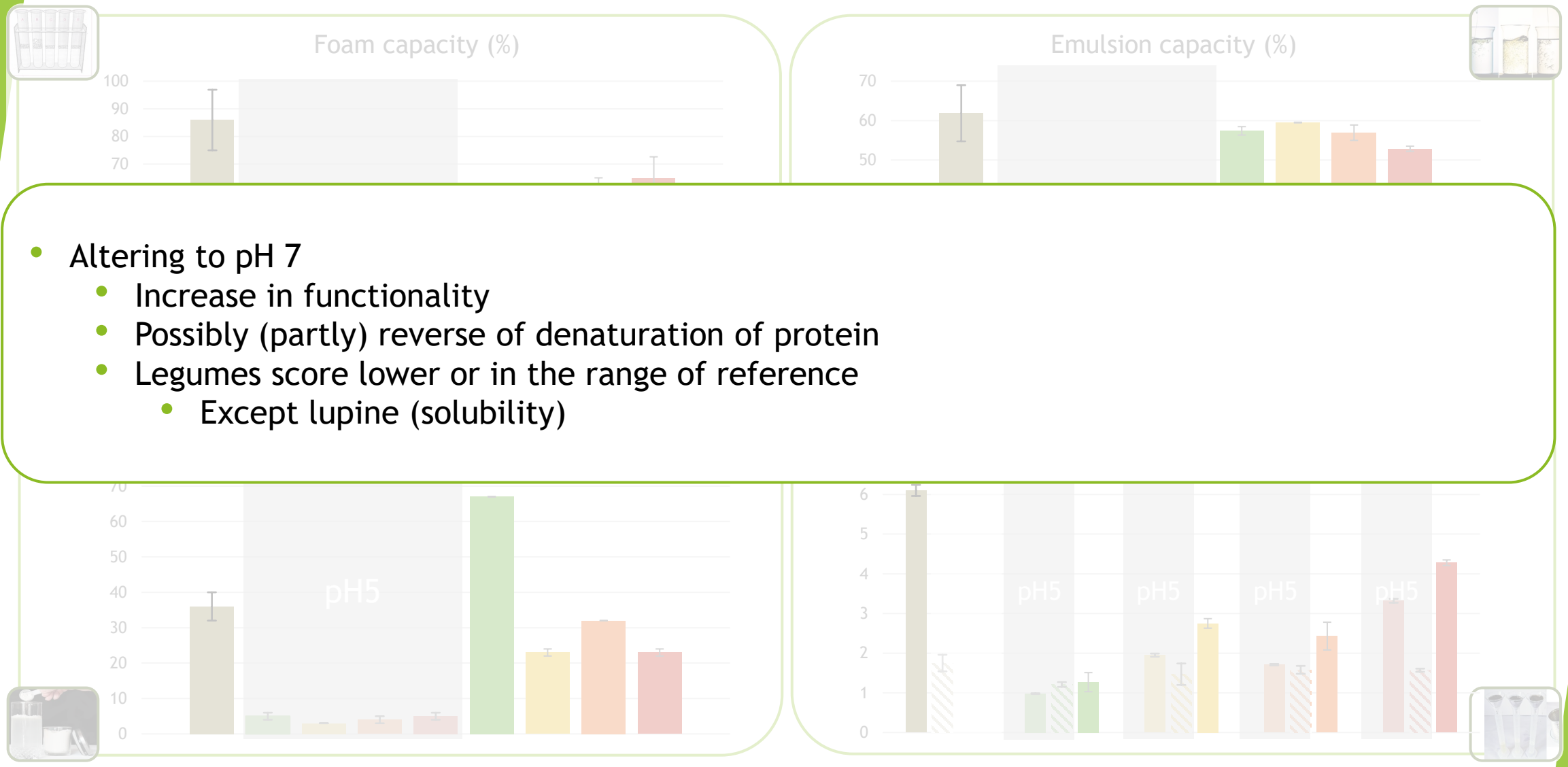
- Increase in water holding capacity for all legumes





Soy Lupine Pea Lentil Bean

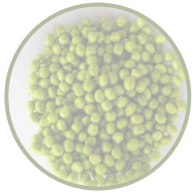
Results - Techno-functionality of legume concentrates altered pH7

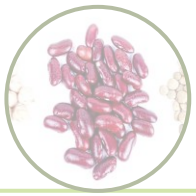


- Altering to pH 7
  - Increase in functionality
  - Possibly (partly) reverse of denaturation of protein
  - Legumes score lower or in the range of reference
    - Except lupine (solubility)

Experimental set-up

Start material





Extraction

AE – IEP

Drying

Freeze drying
pH 5 + milling

Spray drying
pH 7

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Pea - FD
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Bean - FD
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Lupine - SD
70,53% protein
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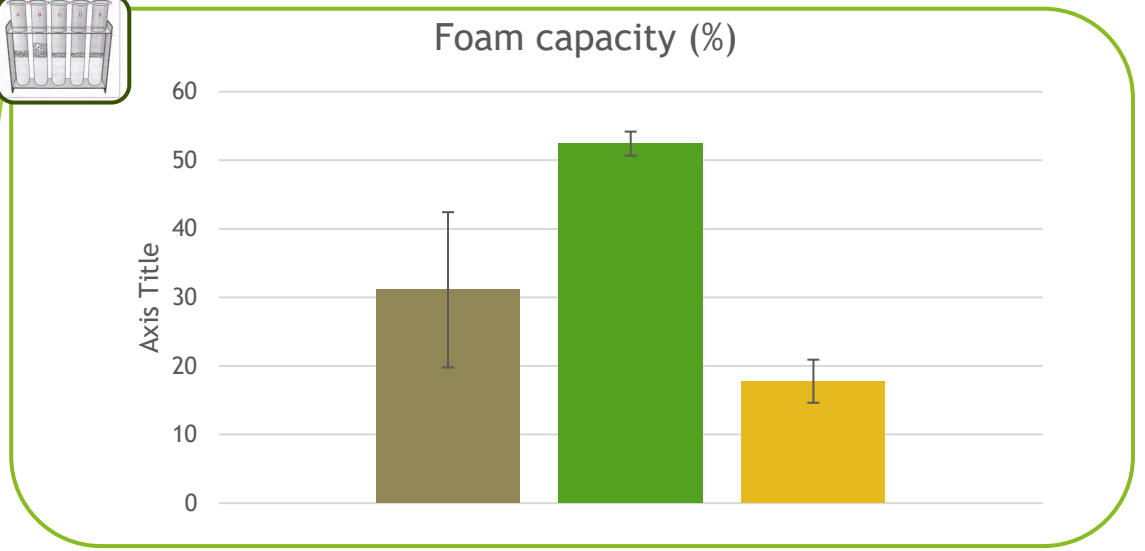
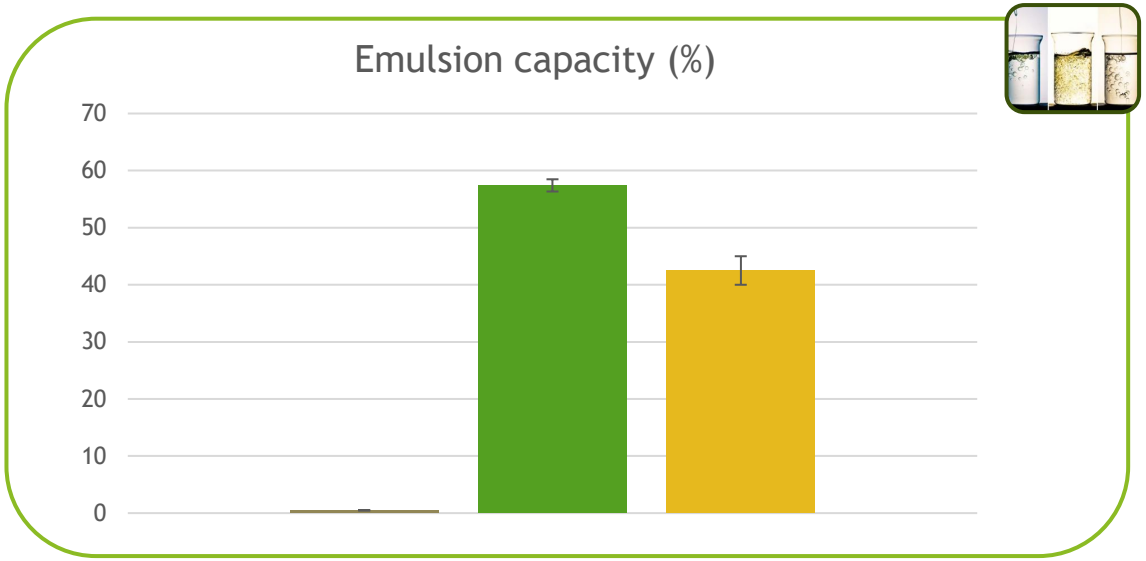
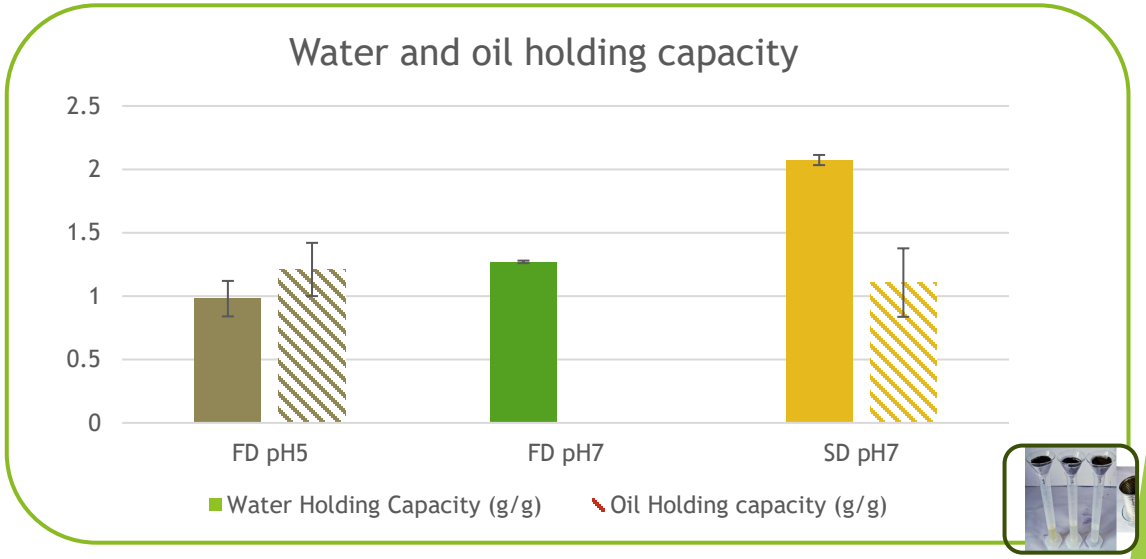
Results - Techno-functionality of lupine protein concentrate freeze dried vs spray dried





- Negative influence on foam capacity
- Small negative influence on emulsion capacity
- Positive influence on water holding capacity
- No influence on oil holding capacity



FD pH5 FD pH7 SD pH7

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Drying

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Experimental set-up

LebensmittelTechnologieberatung

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Extraction

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Drying

Spray drying
pH 7

Functionality

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70,53% protein
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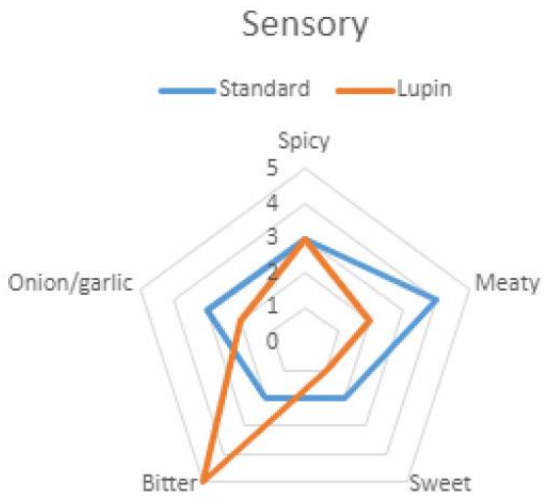


Experimental set-up

Start material

Soaking

Extraction

AE – IEP

Drying

Spray drying
pH 7

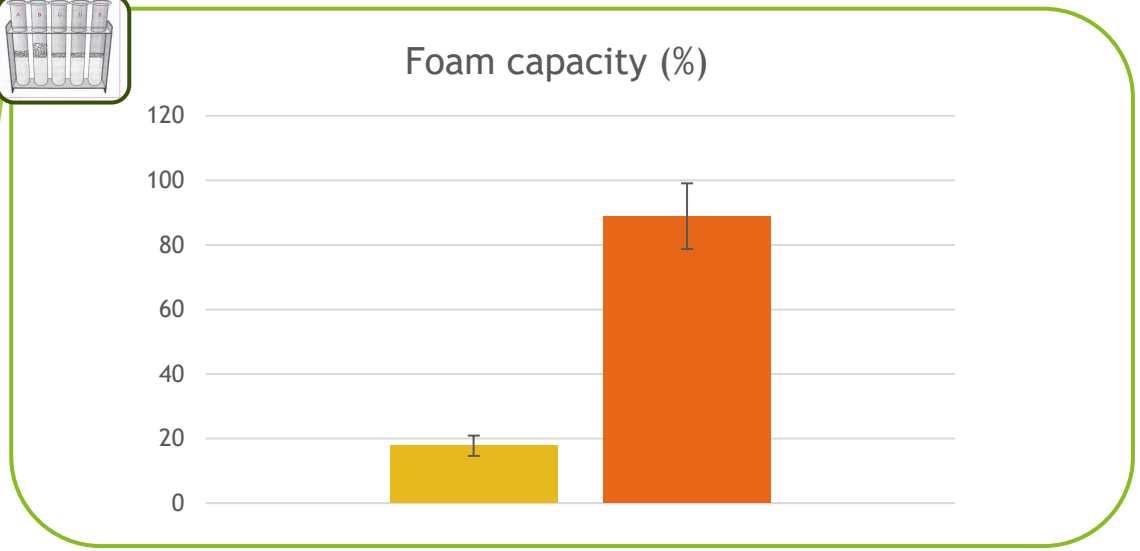
Functionality

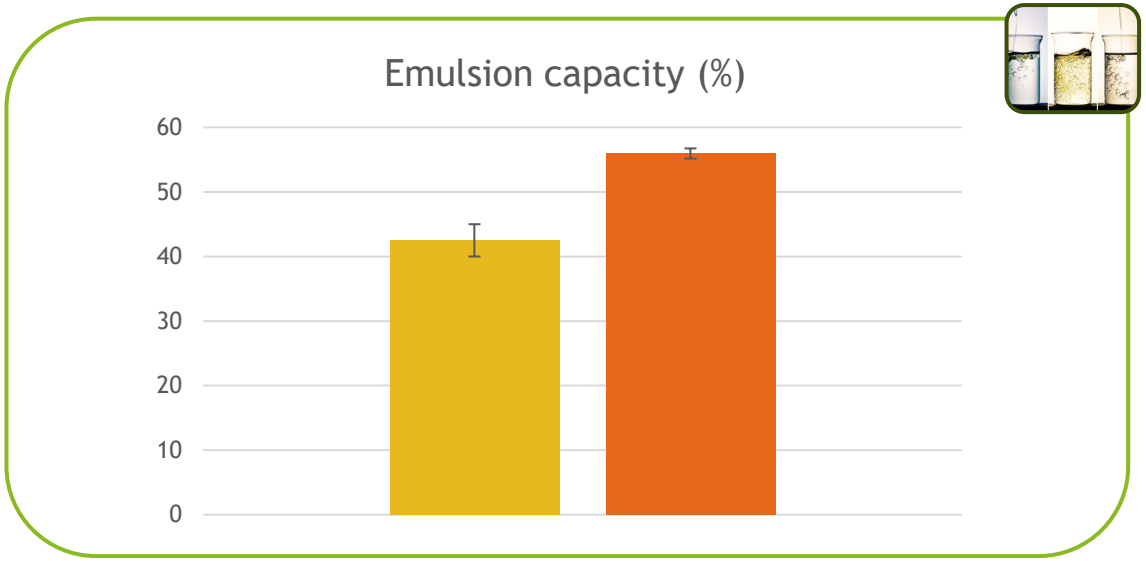
Lupine - SD
73 % protein

Trypsin and phytic acid

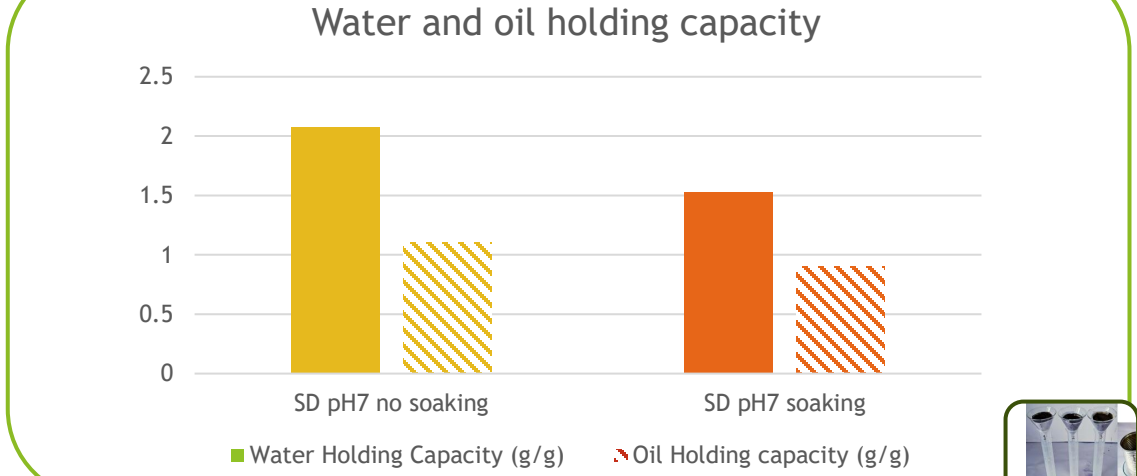
Bitter taste

Results - Techno-functionality of lupine protein concentrate – influence of soaking





- Positive influence on foam capacity and emulsion capacity
- Small negative influence on water and oil holding capacity



SD pH7 no soaking SD pH7 soaking

Results

Conclusion

- Legume concentrates with high protein content
- Functionality of protein
  - Dependent on processing techniques and conditions
- Consider end use of protein extract and work backwards to obtain optimal functionality

Lot of potential
Intended use should be considered

See us in action?

Pilots

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The Hague (The Netherlands), 3-5 June 2025

Thank you for your attention

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