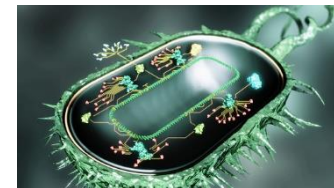




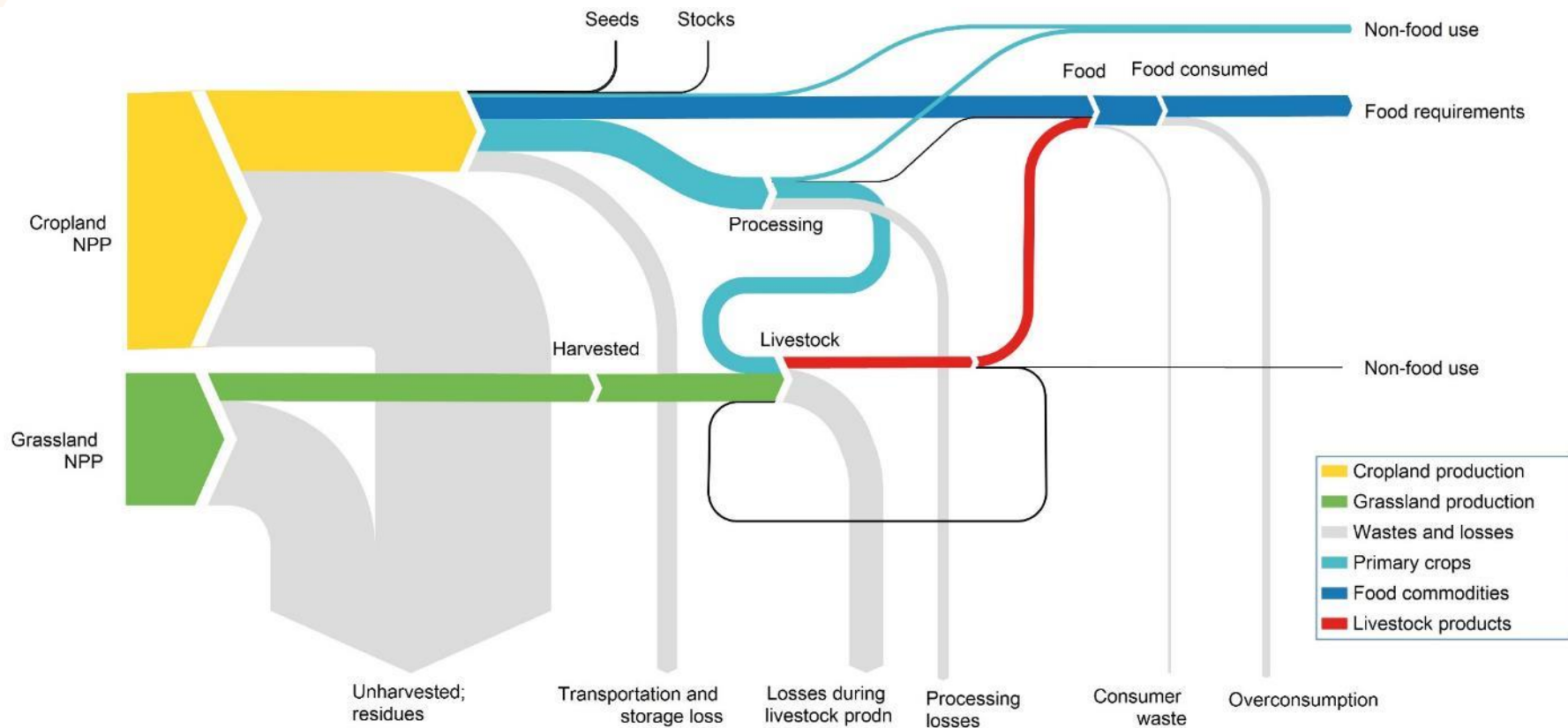
Novel food/feed sources: Food 2030 - Innovative EU research ensures food system is future-ready

https://ec.europa.eu/knowledge4policy/publication/food-2030-innovative-eu-research-ensures-food-system-future-ready_en

Nutrition for more sustainable and healthy diets
Climate resilience and environmental sustainability
Circularity and resource efficiency
Innovation and the empowerment of communities



Global protein streams



Novel raw materials



insects



Cellular dairy



algae



Legumes



Side streams



Solar food



fungi



in vitro meat



by-products



Leaves, stems



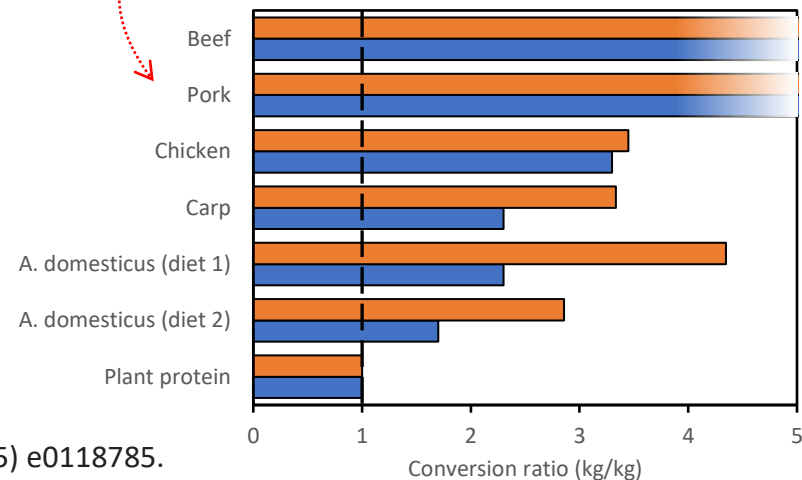
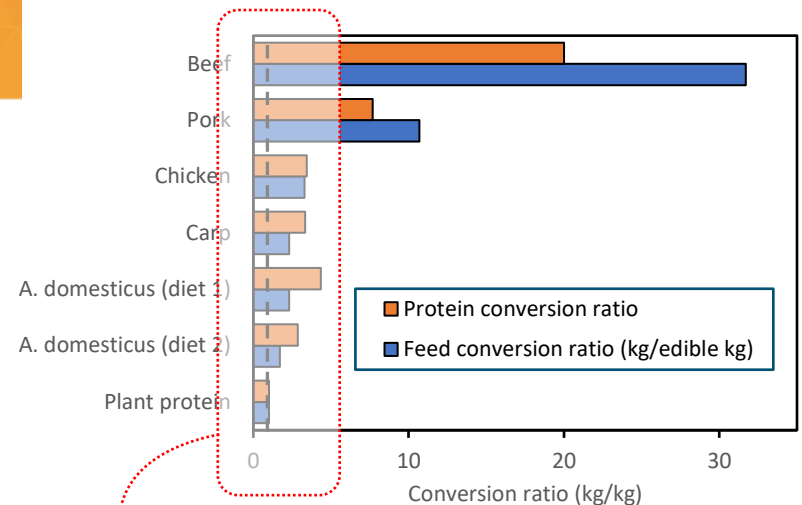
Bacterial



Synthetic

New sources

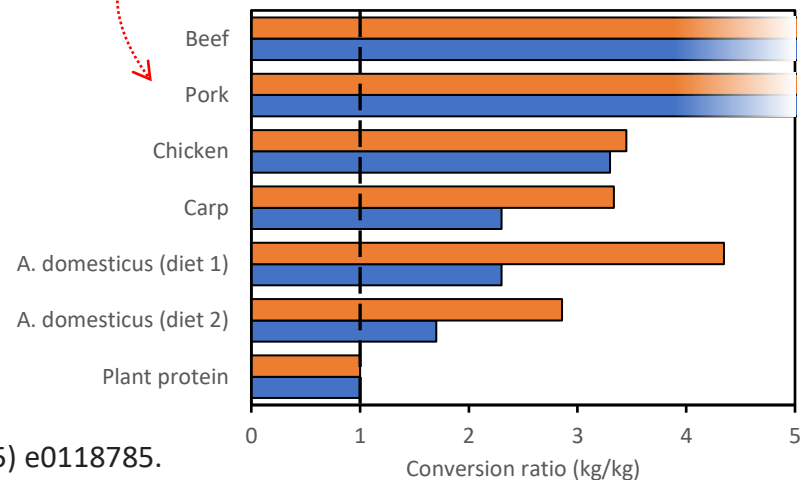
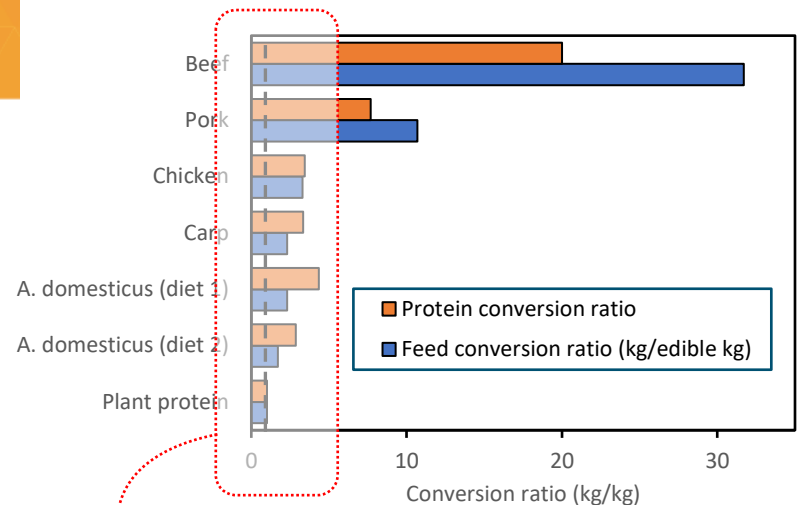
- *More efficient plant - animal conversion*
 - Insects
 - Fungi and bacteria (fermentation)
- *Omitting animal protein conversion*
 - Plant based foods
- *New raw materials*
 - Algae/seaweed
 - (Renewable) H₂ based bacterial fermentation



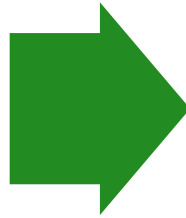
New sources

Insects

- Can extract valuable proteins from waste streams
 - Poorly defined substrate
 - Accumulates toxins from waste streams
 - May remove other toxins
- Growing on edible plant proteins
 - Safe but less efficient than using plant proteins directly



Production of foods



insects



Cellular dairy



algae



Legumes



Side streams



Solar foods



fungi



in vitro meat



by-products



Leaves, stems



Bacterial



Synthetic

Production of foods





Novel food/feed sources: Food 2030 - Innovative EU research ensures food system is future-ready

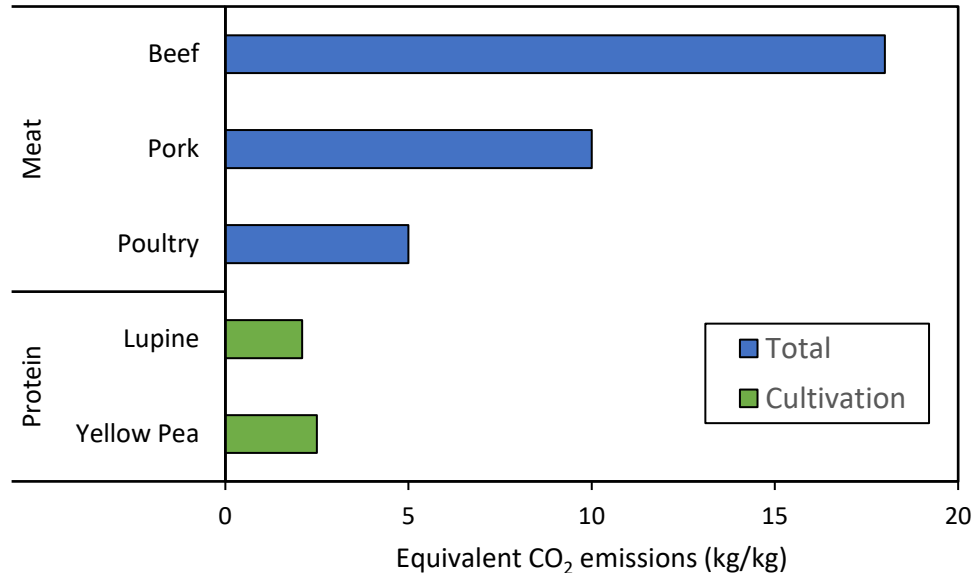
Remko.Boom@wur.nl

Innovation in Food Processing – Safety Aspects



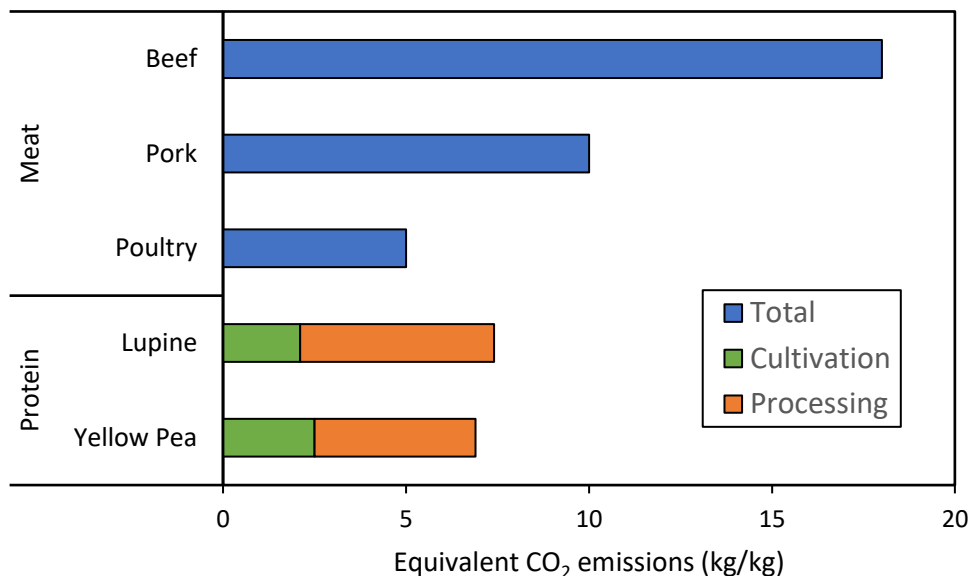
Plant proteins

Equivalent CO₂ emissions for meat and plant protein, per kg protein produced



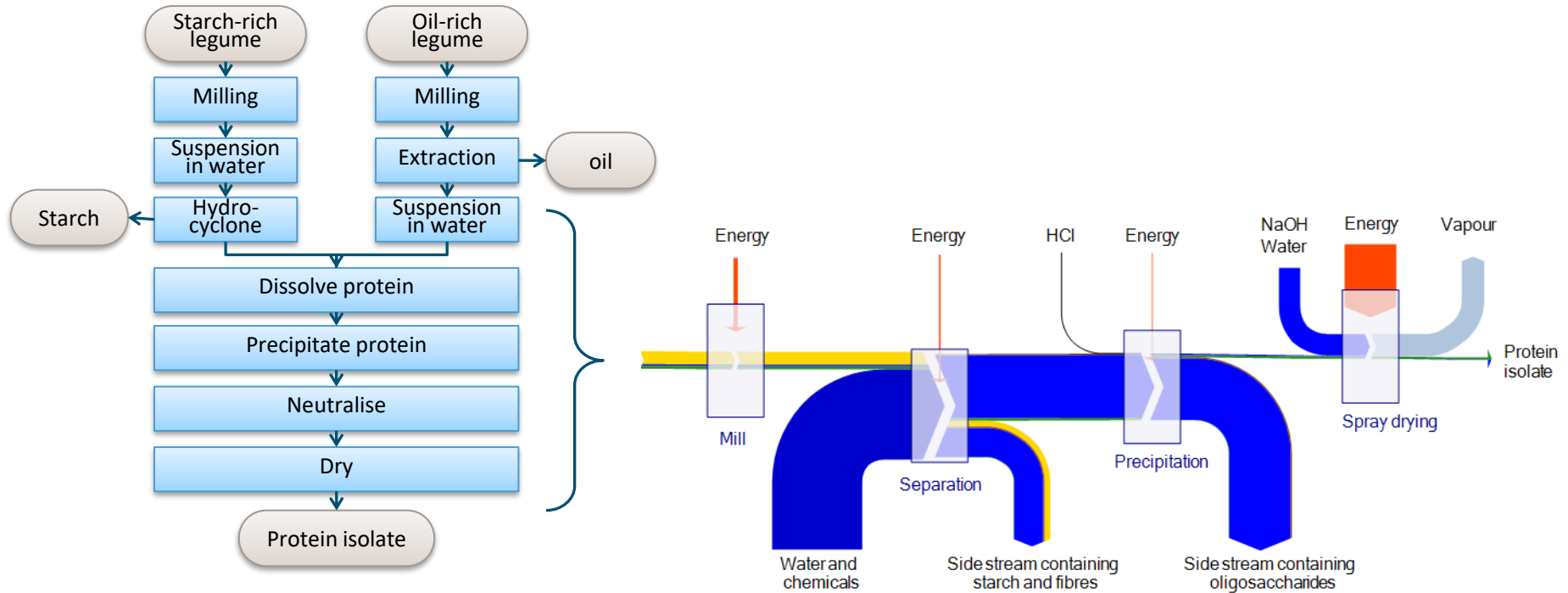
Plant proteins are not by definition more sustainable

Equivalent CO₂ emissions for meat and plant protein, per kg protein produced

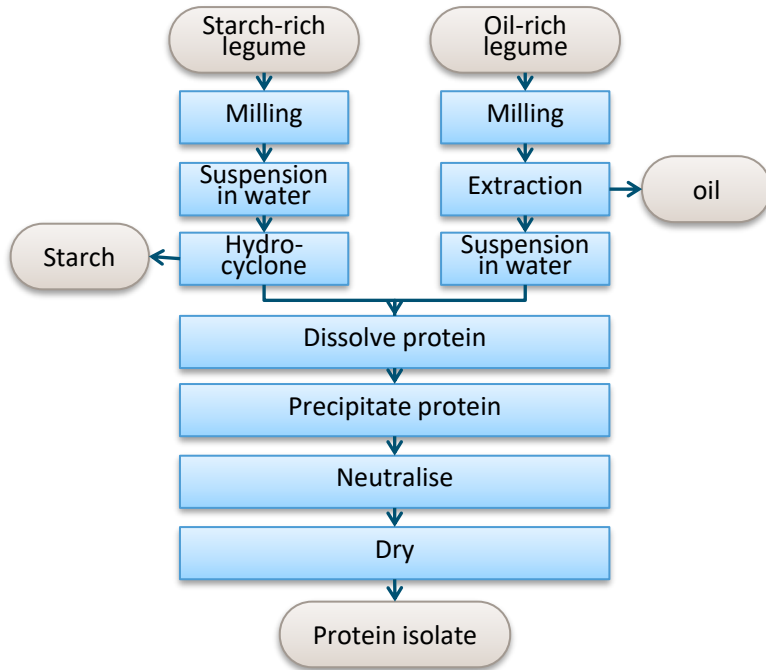


Processing imposes a significant footprint, mostly related to isolation of the protein from the raw materials

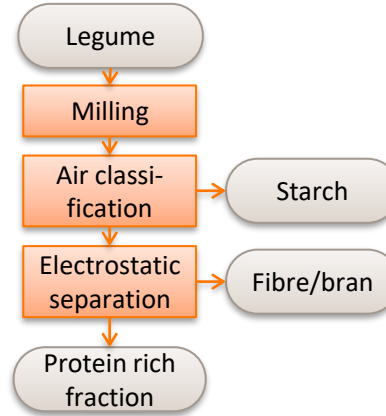
Plant protein production is effective but not *efficient*



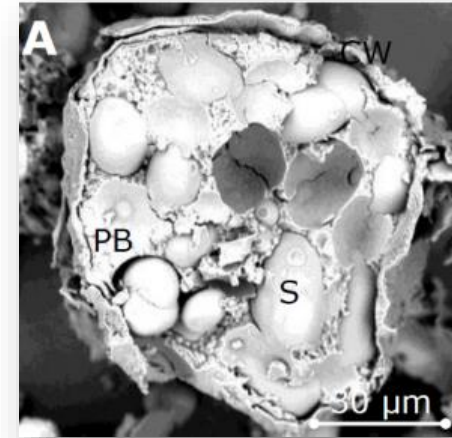
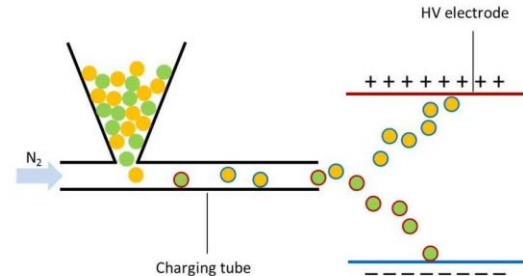
New technology: dry processing



Conventional (wet)



Dry separation



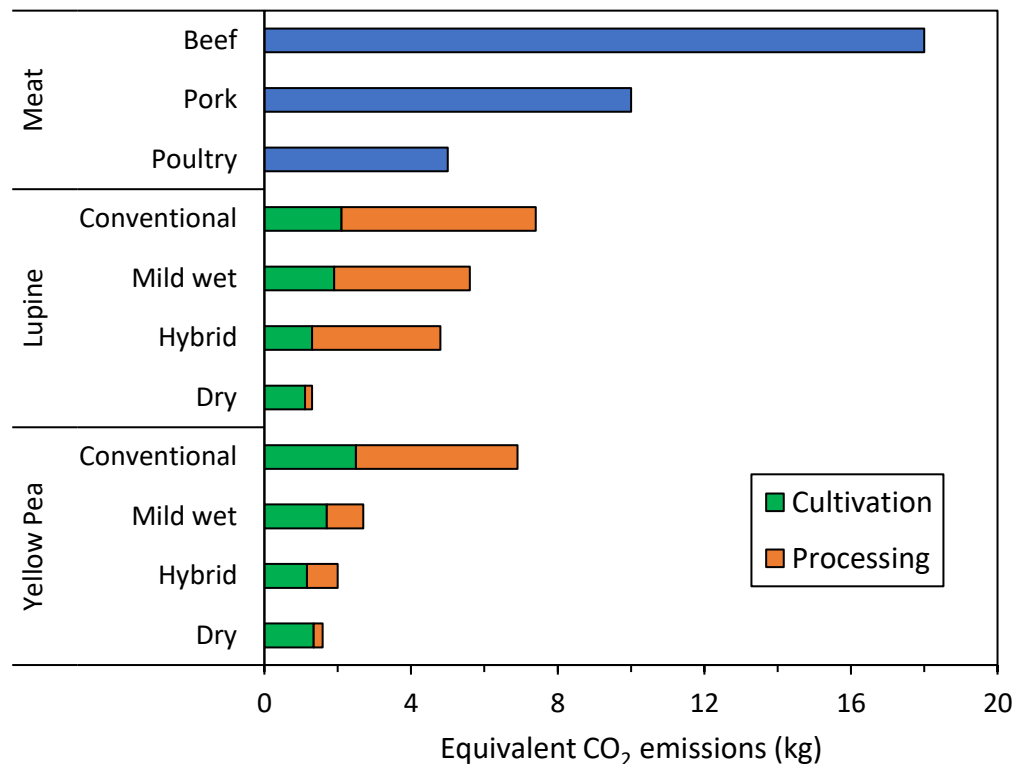
Structure of peas and its flour particles



Plant proteins: efficient processing is crucial

Gentle fractionation makes plant proteins really more **sustainable**

- Reduction in energy, water, chemicals, wastes for processing
- Higher yield means less cultivation necessary (or more foods from the same cultivation)



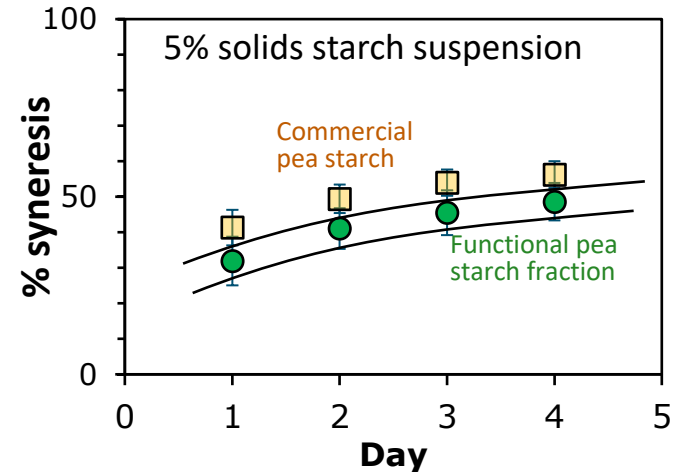
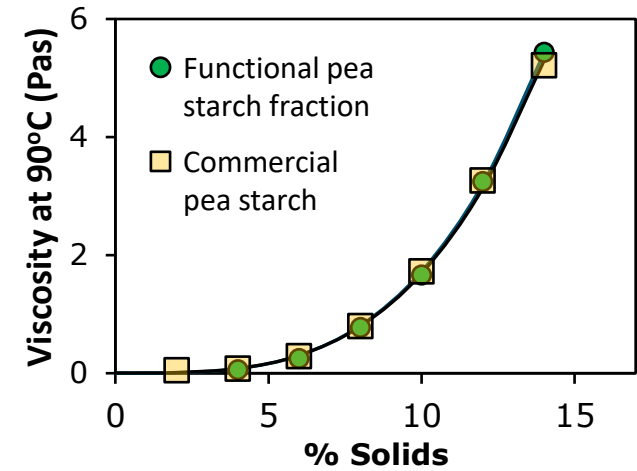
Better properties

- *Albumins* (pea) are excellent **foamers** but are conventionally lost in ingredient isolation²
 - Bakery, drinks, dairy analogues
- *Globulins* (pea) are suitable as **emulsifiers** but are conventionally denatured²
 - Sauces, bakery, dairy products/analogues
- *Combination* of globulins and albumins gives much better **gelation**¹
 - Meat and cheese analogues

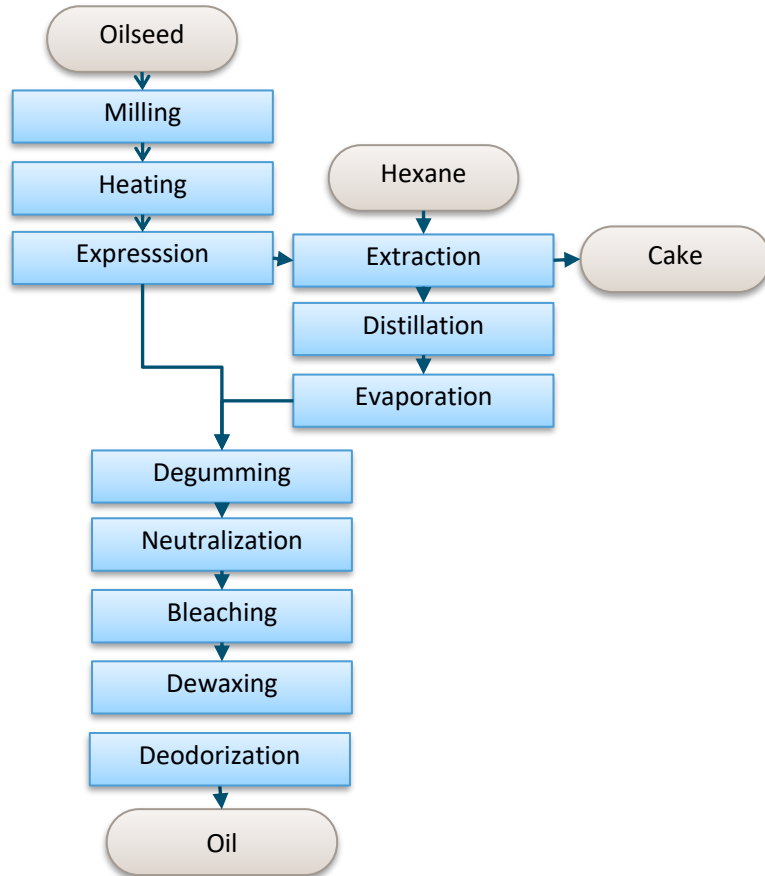


Dry starch separation

- Very similar thickening properties as conventional starch
- Lower syneresis (possibly less retrogradation)
- 32% fibre

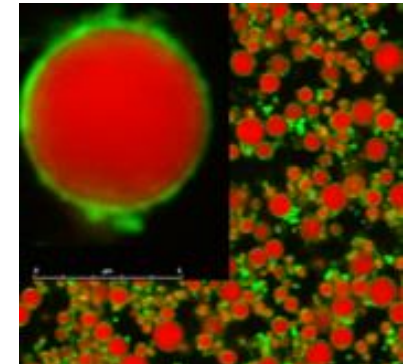
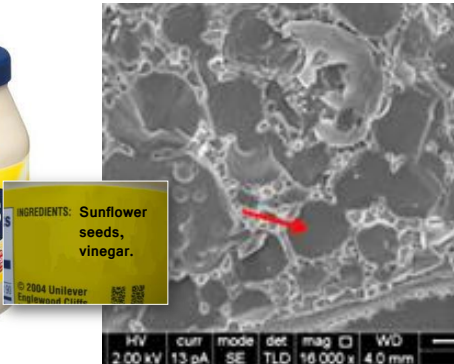
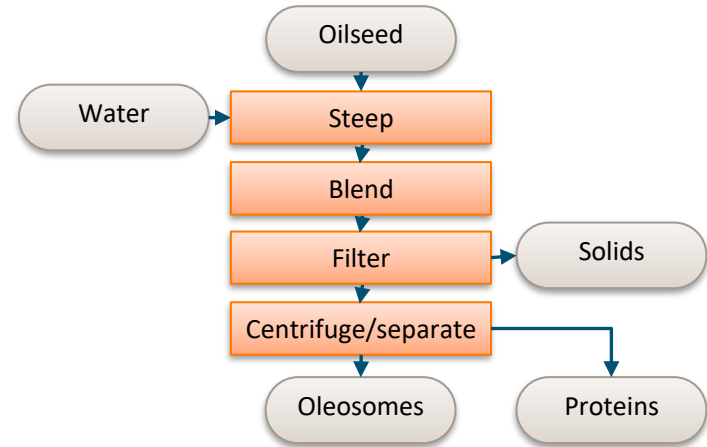
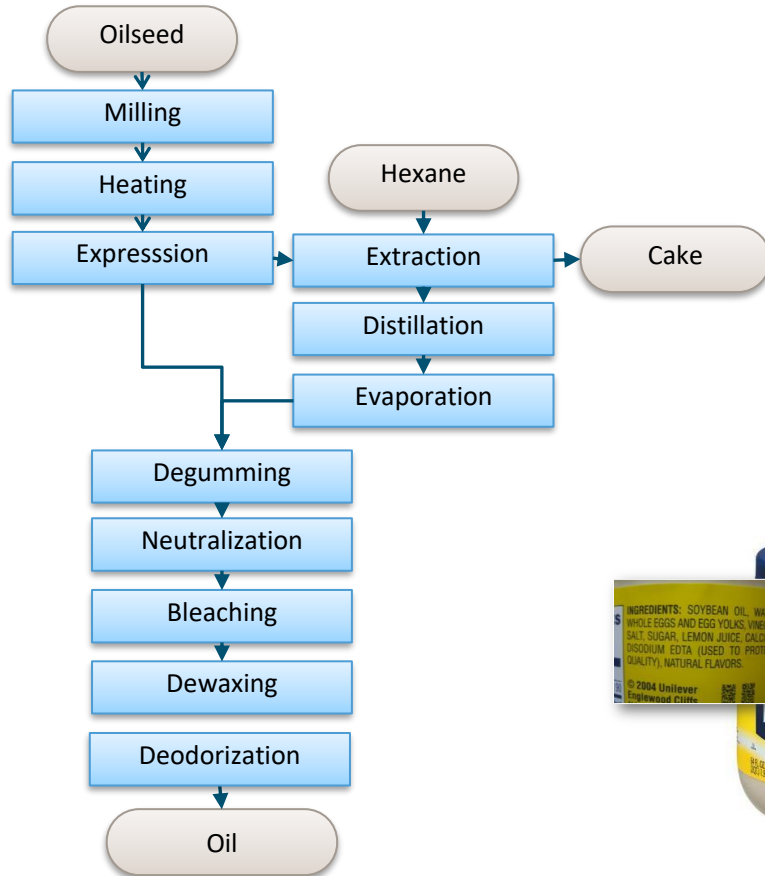


Oil refining: conventional



- Complex process; energy intensive
- Solvent residues
- Oil oxidation
- Loss of nutritional value (phospholipids, proteins, fibre)
- Removal of potential hazards from raw material

Oil refining: conventional vs new ('mild')



Gentle processing: retain & make use of natural microstructure

Starch

Same thickening, less syneresis
more fibre, lower glycaemic index

Protein

Better gelators, emulsifiers and foamers
Superior ingredient for meat analogues

Oils

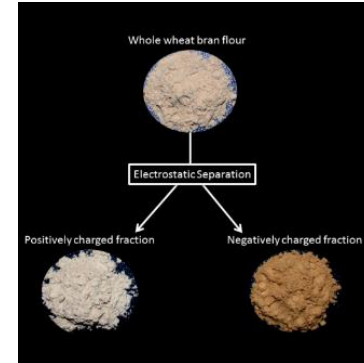
Chemical and physical stability
No additives required (oleosomes + water)

- Cleaner processing
(chemicals, water, solvents)
- Much lower footprint,
better use of raw materials
Less waste
- Better nutritional value
(micronutrients, fibre, satiation)



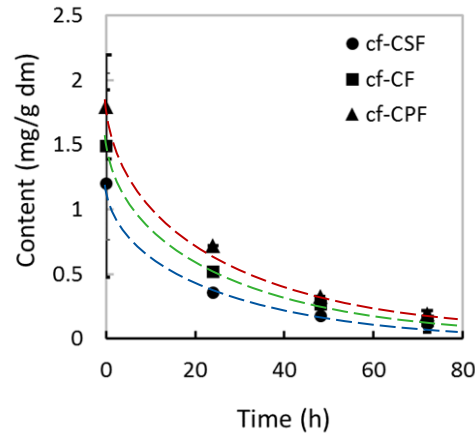
Food safety concerns

- Mild processing
 - Dry processing does not induce microbiological hazards itself
 - Mild and therefore will not by itself inactivate or remove hazards
- Microbiological contamination present in raw materials
- Antinutritional factors
 - Oligosaccharides, isoflavones and other phenolics
 - Lectins/haemagglutinins, alkaloids
 - Protease inhibitors
 - Phytate, oligosaccharides, saponins
- Chemical residues

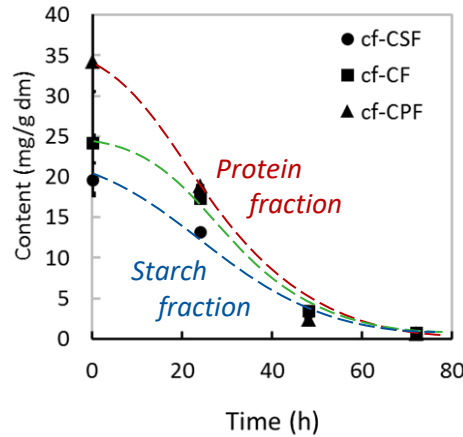


Air classification plant for production of legume protein concentrates

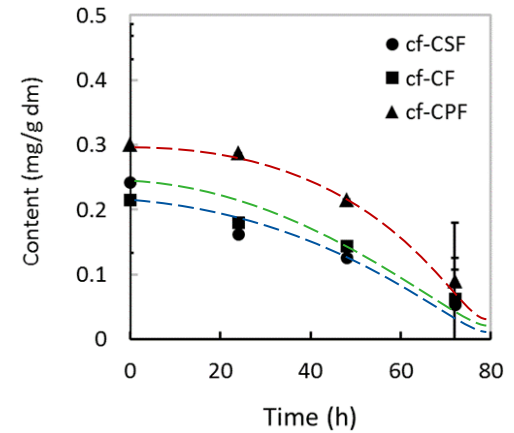
α -galactosides selectively metabolised by lactic acid bacteria



Raffinose



Stachyose



Verbascose

- Spontaneous fermentation or use of defined start culture (based on earlier screening)
- Raffinose ↓ 88.3 ~ 92.3%, stachyose ↓ 97.7 ~ 99.1%; verbascose below detection
- 10 – 50% reduction in phytic acid and total phenolics in protein-enriched fraction

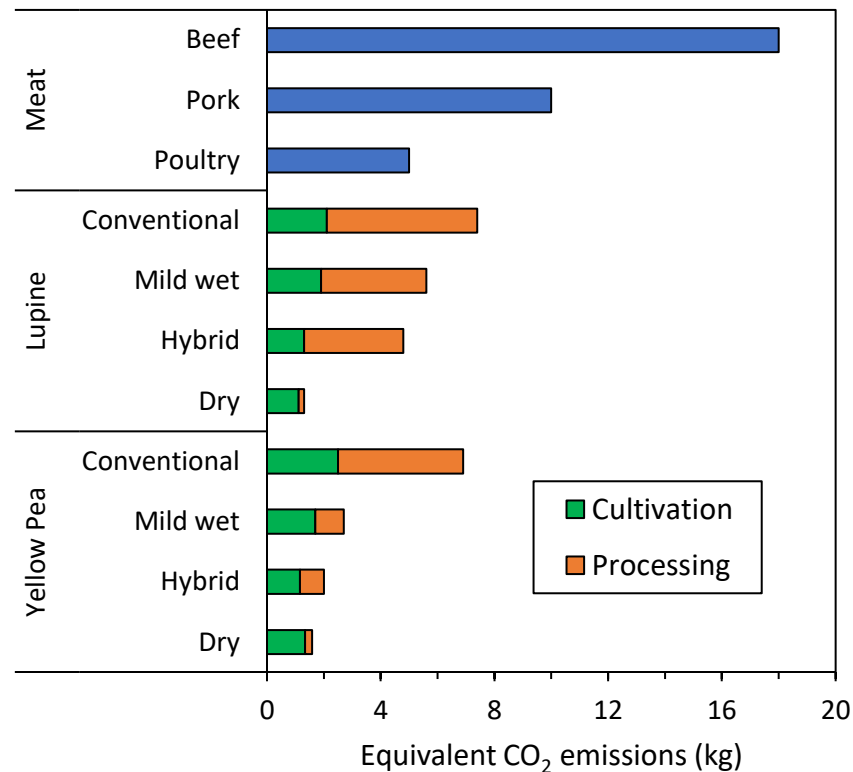
Strategies to remove risks

- Heating and/or washing
- Fermentation
 - Solid state, directed or spontaneous
- Mechanical removal
 - Saponins
- Non-thermal, non-aqueous methods for inactivation?
 - Cold plasma?
- Suited for distributed processing
 - How to ensure food safety in a distributed chain?



Innovative ingredient processing

- The only way to strongly improve the efficiency in the food chain
- Benefits: total use, energy and water, better quality ingredients
- May also cause **new risks**
 - Toxins and other ANFs
 - Chemical residues
 - Microbiological hazards in the raw material
- Distributed processing on the farm
 - Complex control and assurance



- Processing solutions and challenges, for any (new or old) raw materials
 - + Reduction of chain losses
 - + Better ingredient / product quality
 - + Low-temperature, dry and mild processes
 - Reduction in micronutrients
 - Unknown constituents
 - Less refining → more hazards retained
 - New allergens
- New in-process / environmental safety issues
 - Dry processing: dust, sols, risk on explosion
 - Intense electric fields



insects



Cellular dairy



fungi



in vitro meat



algae



Legumes



by-products



Leaves, stems



Side streams



Bacterial

Thanks to everyone of the
**Wageningen Food Process
Engineering Research Group**
and all
Academic and Industrial Partners



Remko.Boom@wur.nl

