Making better use of leafy agricultural side-streams for protein

The example of tomato leaves

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Background

Achieving a full transition from animal to plant protein requires more and a more diverse set of functional proteins for use in food products.

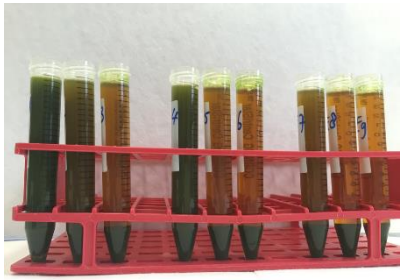
Agricultural side streams, currently commonly discarded, offer opportunities for increased valorization of protein.

Leafy materials are abundantly available.

We develop processing for different targets

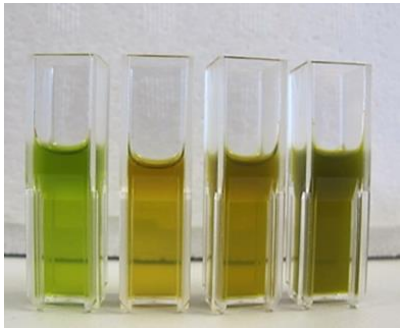
Improve product quantity → Leaf protein concentrate (LPC) for food/feed

- Concentration
- Yield

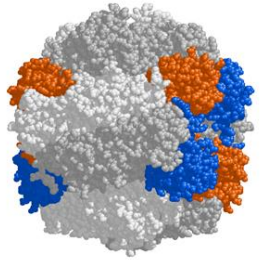


Improve product quality → Rubisco for food

- Solubility
- Functionality, e.g. gelling
- Colour and flavor



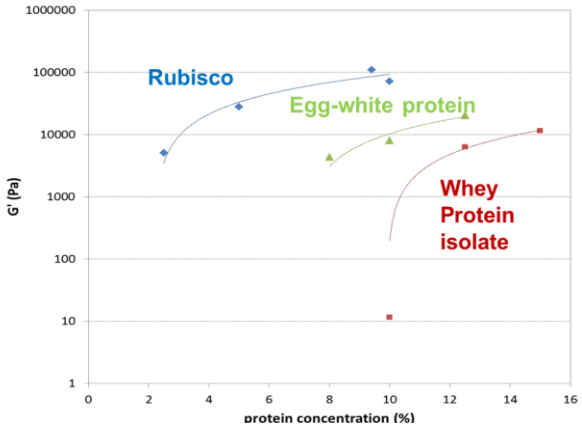
Background on RuBisCO



Water soluble RuBisCo protein from leaves

- is an enzyme that catalyses the first major step of carbon fixation
- is found in all green plants and is the most abundant protein in the world
- has excellent properties for food (2)

Good nutritional value & digestibility (1)
Low allergenicity (3)
Excellent gelling
High foam performance
Good emulsification properties
High solubility (pH dependent)



(1): Barbeau, W. E. and J. E. Kinsella. 1988. Ribulose bisphosphate carboxylase/oxygenase (rubisco) from green leaves - potential as food protein. Food Rev. Int. 4:93-127.
(2): Barbeau, W. E. 1990. Functional properties of leaf proteins: criteria required in food applications. Italian journal of food science 4:213-225.
(3): Leduc, V., de Laval, A.D., Ledent, C., Mairesse, M. Respiratory allergy to leaf proteins involvement of a new allergen. Revue française d'allergologie et d'immunologie Clinique 2008, 48, 521-525

Biorefining of sugar beet leaves

Leaves:
40 ton/ha

Sugar beets:
80 ton/ha

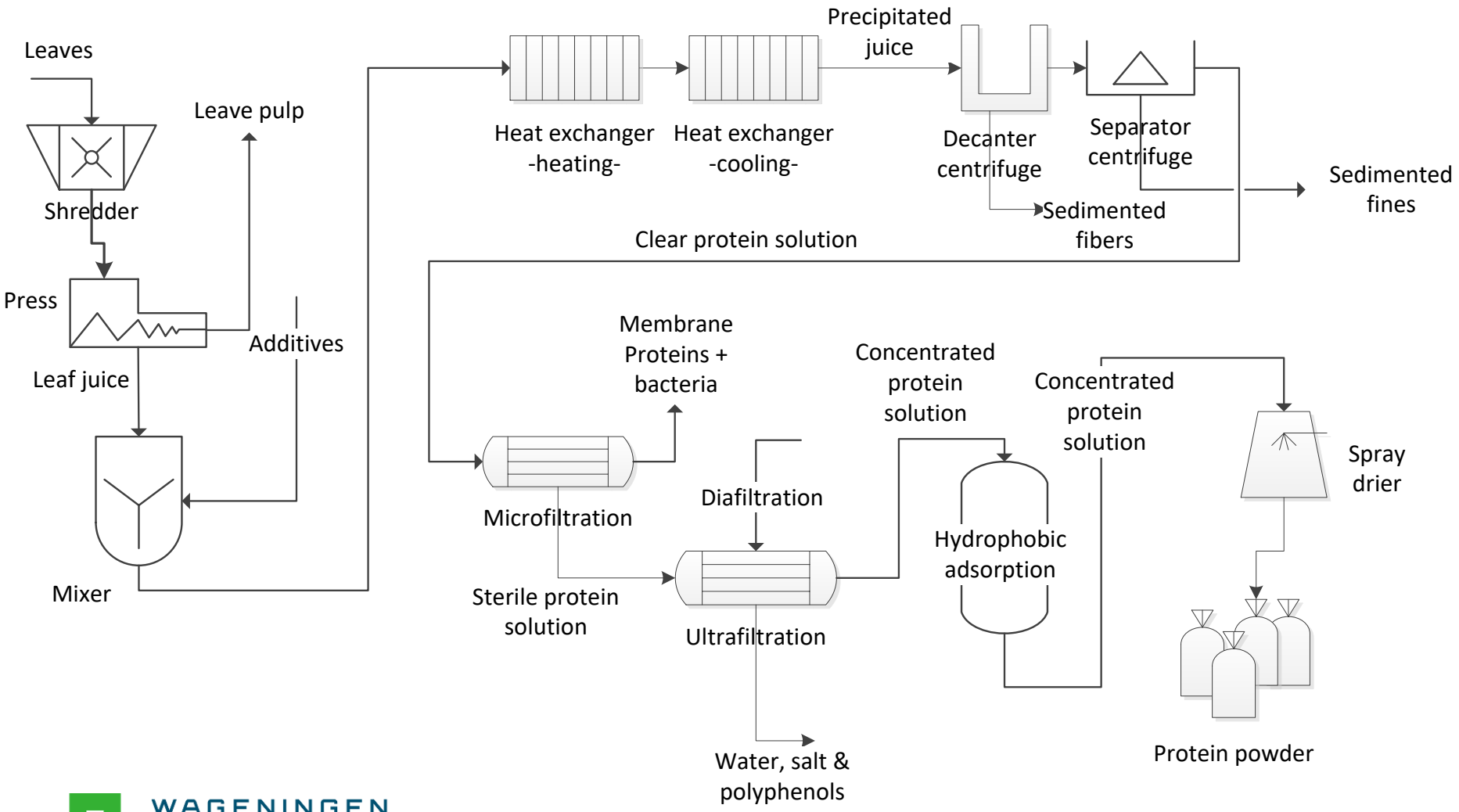
Protein (rubisco)

Protein (feed)

Biopolymers

Biogas

Process design: from leaves to protein



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Scaling up: lab - pilot 1 - pilot 2 - demo

Proteins from tomato leaves

Tomato leaves are less seasonal than sugar beet leaves

Globally, 182 million tonnes of tomatoes are harvested every year. The leftover tomato plants, are regarded as waste.

- Aim: Produce safe and functional protein from these side streams

Research Question: What is **the influence of protein isolation methods** on the composition of the protein isolates?"

- How much Rubisco can be isolated?
- How do the extraction methods influence composition, especially on proteins and toxins?
- What is the functionality of these fractions?

Three extraction methods

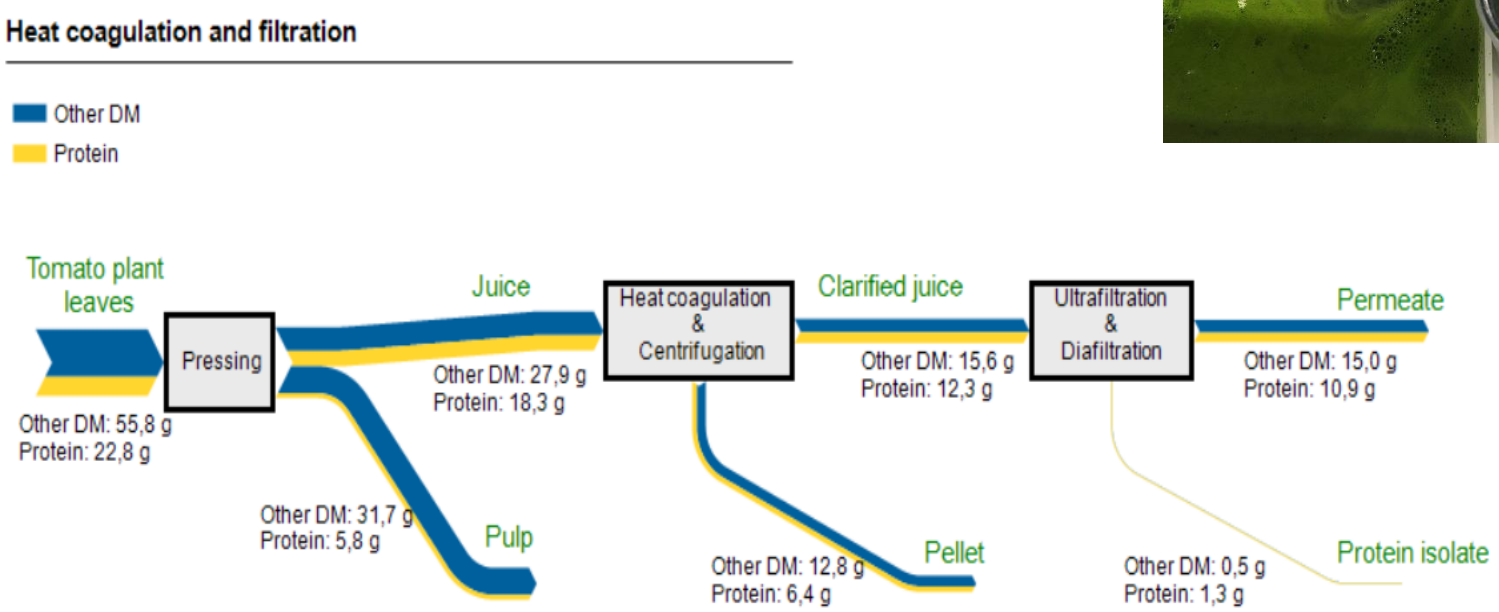
Pressing and centrifugation

pH precipitation

Ethanol precipitation

Heating + UF

Protein & mass balances



Based on 1 kg of wet leaves

Overall protein yield at the end 6-10%

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Protein purity

Good (70-75%) for pH precipitation and Heating + UF

Lower (<50%) for Ethanol precipitation

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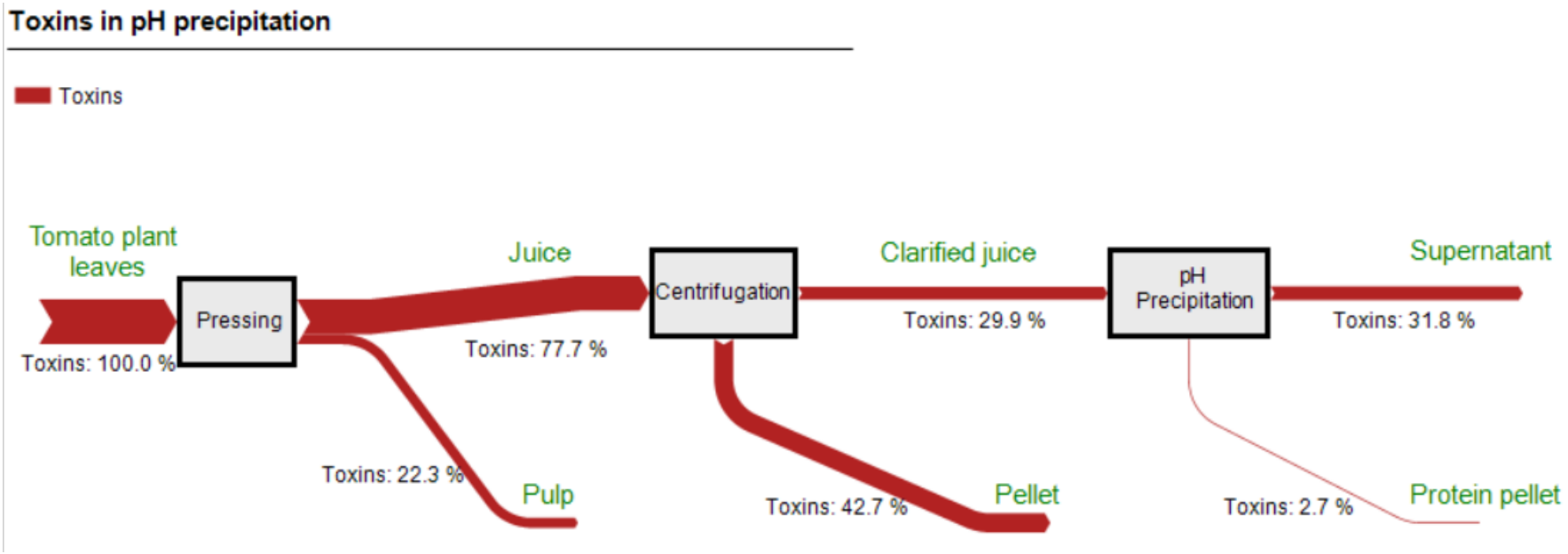
Toxins

Tomatine & hydrotomatine



Functionality: gelation & colour

- pH precipitation
- Ethanol precipitation
- Heating + UF

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Conclusions and outlook

Heating + UF: Low toxins, Good purity

Try to keep the method simple

Improve yield

Total crop use examples

- Pulp: fibres for paper/board
- Pellet: protein rich for insects
- Permeate: liquid for fermentation

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