Disaggregation of conventional vegetable press cakes by novel techniques to receive new products and to increase the yield

Summary

Background:

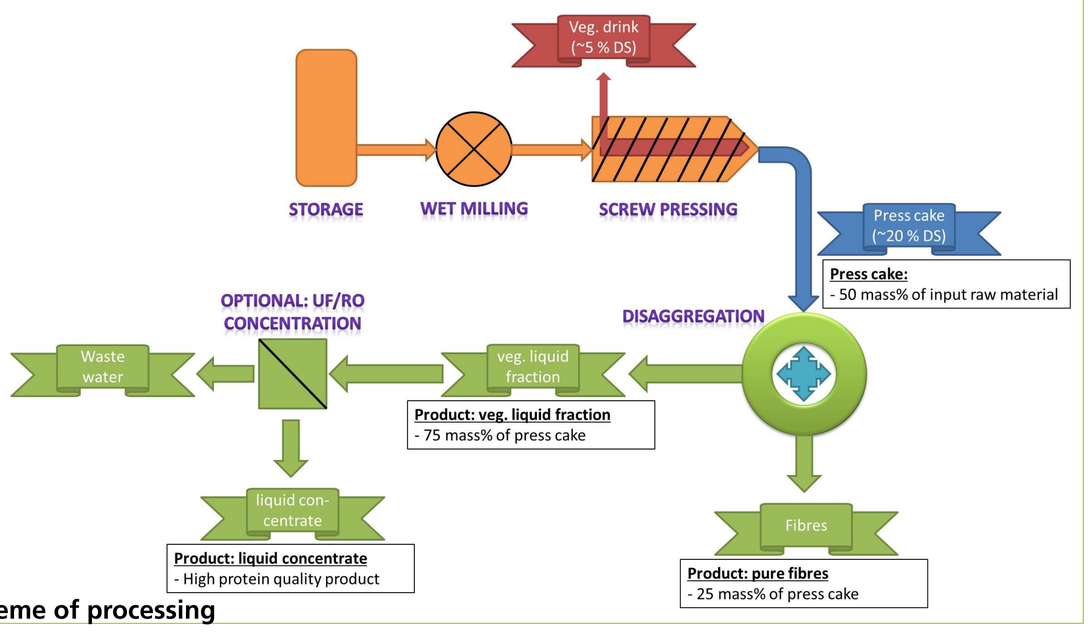
- Vegetal drinks from soy, oat, rice, almond and coconut gain a wide popularity and the market for these beverages is enormously growing
- Within the conventional processing a press cake remains which is only used as feed. However, the content of proteins and other high quality nutrients is still very high
- DISCOVERY aims at unlocking these potentials to increase the yield, efficiency and sustainability within food processing

Work packages:

- Disaggregation of press cakes by a new high-power ultrasound device that induces acoustic cavitation
- Utilization of product streams by separation, enzymatic treatment and concentration steps
- Evaluation of nutritional quality and food safety

Project partners:

- UNIMI: Dep. of Pharmaceutical Science, University of Milan, Italy
- KTU: Food Science and Technology, Kaunas University, Lithuania
- UMSICHT: Fraunhofer Institute for Environmental Tech., Germany
- Berief: Berief Food GmbH, Germany



Scheme of processing

Main objectives / research questions

Utilization of high quality nutrients in press cakes:

- Soy okara and other press cakes still contain a high amount of proteins up to 25 % (dry substance) and additional valuable ingredients.[1)]

Novel high-power ultrasound technology:

- New high-power ultrasound device with oscillation amplitudes up to 60 µm
- Acoustic cavitation disintegrates vegetable cell structures of press cakes making an extraction of the containing proteins possible

Separation and concentration:

- Liquid phase with high amount of proteins for beverages and yogurt / tofu production
- Fiber fraction for meat analogues or bakery products

Enzymatic treatment:

- Disaggregation of press cakes and treatment of liquid and solid fraction

→ What are the optimum process parameters to disintegrate the press cakes?
→ How does the ultrasonic treatment effect nutritional quality and food safety?
→ Can the process be applied to increase the yield in food production?

Sources: 1) B. Li et al.: "Isolation and Structural Characterisation of Okara Polysaccharides", (2012) Molecules 17(1), p. 753-761

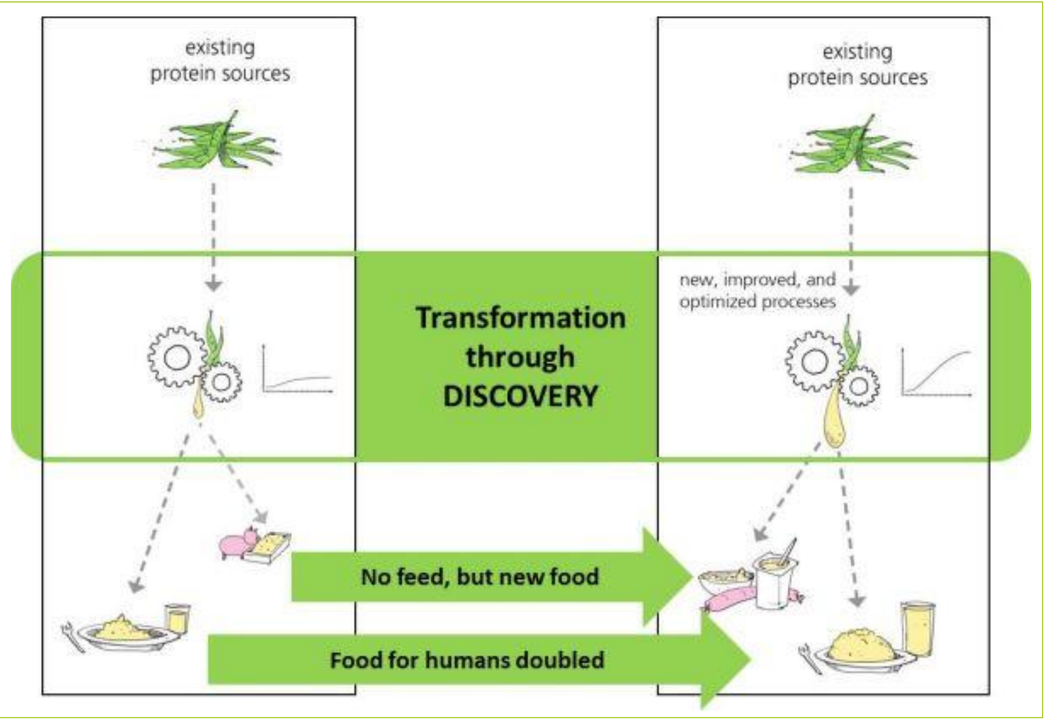
Preliminary results

- High-power ultrasound treatment (18 kHz, 4.5 kW, 60 µm) can disrupt vegetable cell structures and thus makes protein extraction possible
- For soy okara, optimum process parameters concerning temperature (60 °C), treatment time (2 min), batch size (5 L), power input (4.5 kW) and dry matter content have been identified and will be confirmed in the following work
- Enzyme selection for press cake treatment based on solubilization, fermentable sugar formation and protein recovery
- Optimal ratios of enzymes (amylase, cellulose / xylanase, protease, carbohydrase) and optimal hydrolysis temperatures and times were identified for different press cakes
- Methods for characterization of food quality have been identified and applied: Ultrasound treatment shows effects on protein content in liquid fraction; total amount of proteins is increased and the SH-free content is reduced possibly indicating changes in secondary and tertiary structure

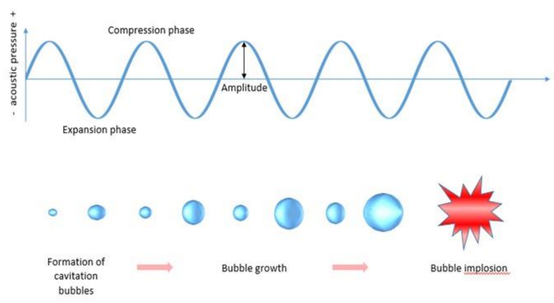
Preliminary conclusions / potential impact

- Experimental results for soy okara show that high-power ultrasound is effectively disaggregating vegetable cell structures; transformation from batch to continuous treatment and further processing by concentration will follow
- Process parameters to be confirmed and adapted on further press cakes (oat, rice, almond, coconut, etc.)
- Enzyme treatment and / or use of fiber fraction for meat analogues show good potential
- Results concerning food quality and safety underline the feasibility of the process

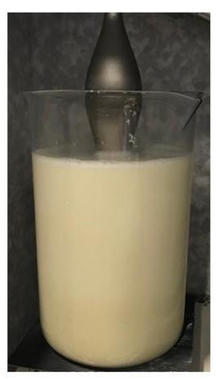
→ Process improved and optimized within DISCOVERY can lead to an increase of protein yield in human food production
→ Food processing will become more efficient, economic and sustainable



Insights in experiments



Effects of high-power ultrasound induce acoustic cavitation and lead to cell disruption



Ultrasound treatment of vegetal press cakes to increase protein yield

Before and after ultrasound treatment:
Soy okara with water

Separation into liquid and solid fraction

Topic 1: **Innovation in food processing technologies and products**