Steering protein functionality using smart dehydration

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Motivation

The 'Nutrition Targets' set by the World Health Organisation, and the 'Sustainable Development Goals' defined by the United Nations emphasize the urgency of healthy and sustainable food. As pointed out in the Green Deal of the EU, a more sustainable society requires the transition from animal-based to plant-based proteins[1]. This project targets protein-containing streams in the (potato) food industry that are currently considered waste. If these proteins could be separated or fractionated effectively they provide an alternative protein sources for animal-based proteins. Apart from sustainability issues, this strategy also adds to the product portfolio of food manufacturers[2].

Technological challenge

In general, the protein concentration is low in the previously mentioned streams, thus effective separation and dehydration methods are needed. Because of this, extensive water removal is needed to reach appropriate starting materials for the food industry. All this asks for effective separation and dehydration technologies. It is, however, essential that the methods employed preserves protein functionality, are used to steer functionality toward different applications in food. The functionality studied in this project is the coalescence properties of oil droplets coated with these particular plant proteins. As for process conditions, special attention will be paid to the effect of temperature and the oxidation level on protein functionality. Figure 1 shows the overview of the protein separation and functionality studies.

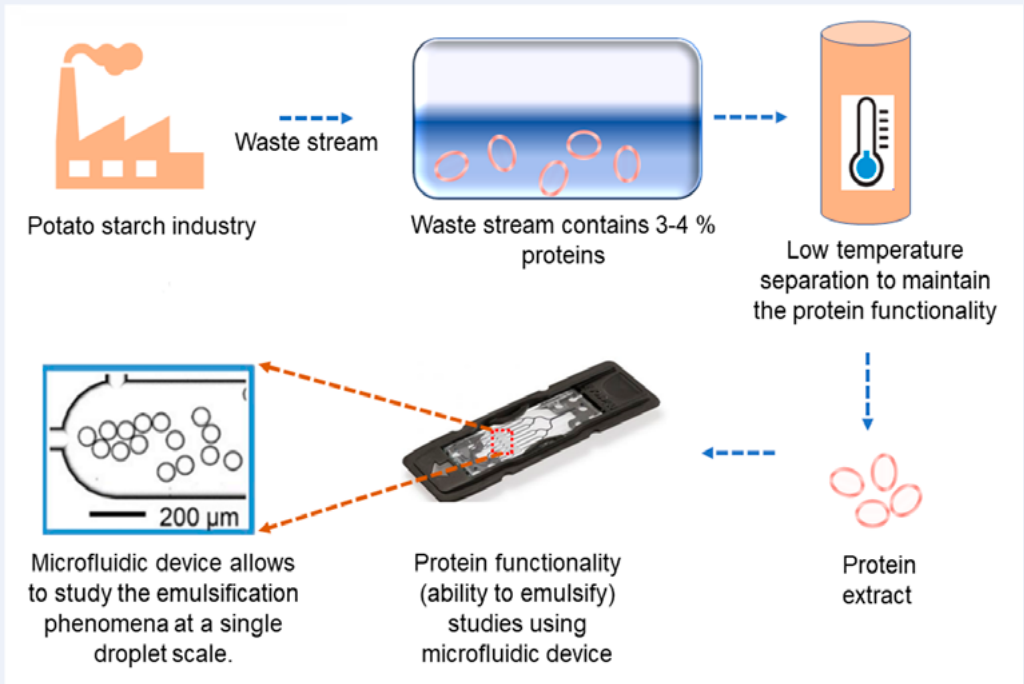

Figure 1: Schematic overview of the research project.

Measurement method

Microfluidics allow droplet formation and coalescence investigations at the millisecond time scale[3] based on many observations done within a very short time. We start our investigations with the so-called coalescence chamber (see Figure 2). In the T-junction (red rectangle) droplets are formed under well defined conditions. In the coalescence chamber, the size of the droplets can be observed at various spots (green and blue rectangles, for example), which is indicative of the functionality of the protein. The droplet formation time and droplet interaction time can be systematically varied through the length of the meandering channel (in Figure 2, connecting the red and green rectangles). This allows for detailed analysis and is comparable to conditions as would occur in industrial practice. The kinetics of coalescence thus is a measure of the emulsifying behavior of the protein-coated oil droplets.

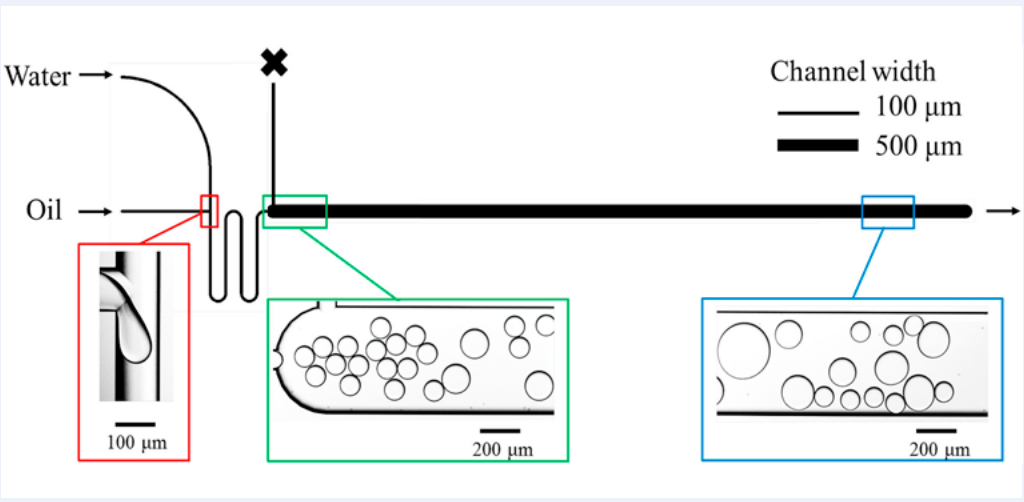

Figure 2: Schematic of the microfluidic device.

Research goals

- Study the emulsifying abilities of potato proteins using a microfluidic device and determine the optimal concentration of protein required to stabilize the emulsion.
- Investigate the effect of protein oxidation on emulsification.
- Study the effect of operating temperature during protein separation on emulsification.

References

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[2] Liu, Z., Wu, Z., Li, R., & Fan, X. (2013) *Journal of food engineering, 114*(2), 192-198.
[3] Hinderink, E. B., Kaade, W., Sagis, L., Schroën, K., & Berton-Carabin, C. C. (2020) *Food Hydrocolloids, 102*, 105610.

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