Applicability of product-driven process synthesis to separation processes in food

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Introduction:

Okara is produced in large amounts during soymilk production (Fig.1). It has a moisture content around 80%, and is considered as an industrial by-product. We want to utilize this by-product by isolating the **isoflavones** present in the material. Isoflavones are polyphenolic components considered to have certain health benefits.

Product-driven process synthesis (PDPS) is a recently established method to facilitate the rapid development of feasible process alternatives during conceptual process design in the food industry. Amongst others, it considers the role of the microstructure of food products (e.g. mayonnaise).

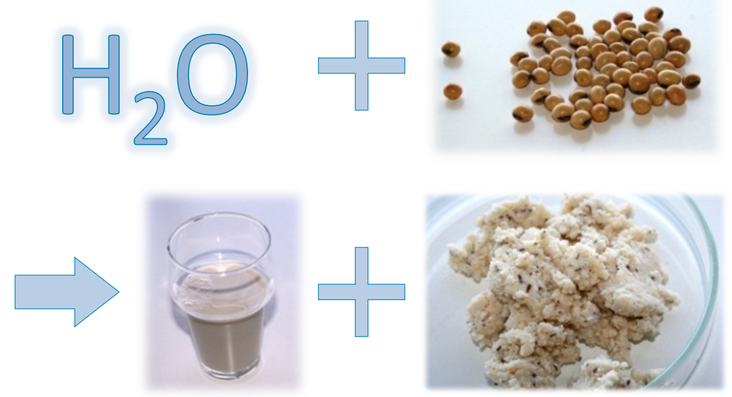


Fig. 1 Input/output of soymilk production (bottom right: okara)

The aim of this project is to develop a sustainable, cost effective, and mild process to separate isoflavones from okara. This will be done by using and extending the PDPS methodology for processes, in which the food matrix plays an important role for separation.

Methodology:

Level	Description
0	Framing
1	Consumer wants
2	Product function
3	**Input/output**
4	**Task network**
5	**Mechanism and operational window**
6	Multiproduct integration
7	Equipment selection or design
8	Multi product-equipment integration

Fig. 2 Levels of the PDPS methodology (Bongers 2009)

Growing interest of the food industry to translate conceptual design methodologies from the chemical sector into the food sector lead to the development of the PDPS approach, which is based on the systems engineering strategy. It expands on a previously developed approach of hierarchical decomposition, and its levels can be seen in Fig.2. Within each level a number of activities (such as generation, analysis, and evaluation of alternatives) are performed. The separation of isoflavones from okara is used to study the applicability of PDPS to separation processes in food.

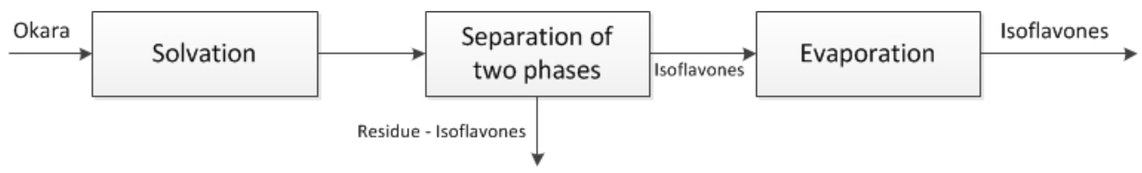
Results:

- Separation processes lead to impurities and uncertainties in the compositions of the streams.

  ⇨ Increased number of in- and output structures and task networks (example see Fig. 3).

- Specific challenges for okara in the process design are very low starting amounts of isoflavones, and its high swelling capacity (see fibre content Tab.1).

Fig. 3 Example of a task network



Tab. 1 Composition of okara (% d.w.)

Insoluble dietary fibre	Soluble dietary fibre	Proteins	Fat	Isoflavones
41.06	3.16	32.0 ± 0.4	14.6 ± 0.03	0.12 ± 0.01

- Involvement of experimental experience is necessary at an earlier stage compared to the PDPS for a structured product. Experimental exploration of the basic behaviour of the food matrix and components within the matrix will greatly support the decision-making process and refinement of fundamental tasks within the PDPS methodology.

Conclusion:

Since the need for a more sustainable use of resources rapidly increases, PDPS is now also used to upgrade a structured by-product of the food industry. Applying the PDPS methodology to an already existing structured food product may require some extensions of the methodology due to the fact that a structure has to be decomposed instead of built. The extension includes a continuous information exchange between experimental work and design.

Acknowledgements

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