

KoMSO Challenge Workshop

“Mathematical Modeling, Simulation and Optimization in Food Industries“

March 17-18, 2016

Trier University

1 Point of Departure

Food is a daily aspect of life. Thus, every mathematical modeling, simulation and optimization (MMSO) result will have immediate impact on society. The industrial production and handling of food poses interesting and challenging mathematical questions of non-standard nature. The aim of this workshop was to discuss a variety of mathematical aspects in food industry and to find out possibilities for future cooperation. These range from modeling, simulation and optimization of growth and microbial activity over food processing with aromatic facets up to logistics of distribution.

2 Challenge Workshop

The challenge workshop “MMSO in Food Industries” was organized by the Committee for Mathematical Modeling, Simulation and Optimization (KoMSO) with financial support from the Federal Ministry of Education and Research (BMBF) via the “Accompanying Networks” project (IMNet). Local organization was provided by Trier University and the group of Prof. Dr. Volker Schulz.

Industry representatives in the discussion panel included participants from Nestlé Research Center, Südzucker AG, GAMS Software GmbH and Dienstleistungszentrum Ländlicher Raum (DLR). In addition, participants from academic institutions included but were not limited to: Fraunhofer Institute for Industrial Mathematics ITWM, Heidelberg University, Hochschule Geisenheim University, Peoples Friendship University of Russia, School of Life Sciences at TU Munich, Trier University, University of Cologne, University of Guelph in Ontario/Canada, Würzburg University, and Zurich University of Applied Sciences (ZHAW)/Switzerland.

The intensively and openly discussed talks resulted in two discussion forums with the following outcomes:

3 Major Topics

The following topics formed the central points for debate:

- How can quality criteria of food be described in a precise fashion and maybe even in scalarized form, which later on may serve as optimization objective?

- Safety aspects of food are a delicate issue due to biological contributions. Are tools from mathematical biology sufficiently developed?
- Contributions to food science from mathematics are highly welcome but need to be integrated in an interdisciplinary fashion. Communication between academic mathematicians and mostly engineers in food industry is demanding. Can we find interpreters?
- Is the topic of this workshop too wide? Should we narrow it down to selected aspects of food in the future?
- How can we properly address confidentiality aspects of research?

4 Challenges

Collaboration between mathematics and food industry is not very much established yet. There are clusters in industry of some representatives who deal with mathematical aspects but most of them are not really aware or do not care so far about the potential of mathematics. On the other hand, this means that there is room for strong impact of MMSO. In that respect, the following subjects were identified as prospective collaborative research areas:

- Investigation in mathematical formulations of quality criteria of food.
- Investigations in mathematical modeling of flow behavior of food bridging the scales from statistical physics to continuum mechanics. Also multiscale numerical simulation is an issue here.
- MMSO of biological components in food production (e.g. fermentation) and product safety (e.g. bacteria causing degradation).
- Mathematical examination of aspects of current production trends: centralization of food production in large companies versus delocalization in the form of small local production units. The modeling of these aspects immediately leads to very complex models with stochastic, continuous and discrete aspects.
- Supply chain management and logistics are very important aspects, which require improvement in terms of mathematical methods. Besides the cooling chain; there are, however, not very specific demands with respect to food.

5 Outlook

All participants agreed that the workshop offered a much-needed platform to raise awareness of the potential of MMSO for food industry. It has been suggested to organize one or two follow-up workshops with a clear focus in approximately 2 years: one workshop devoted to production and safety details involving continuous MMSO, and another workshop on logistics aspects involving researchers from discrete optimization.