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# Conventional and novel thermal processing techniques for sustainability and improved process design

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Thermal processing has been applied to provide safety and increase the shelf life of food products. While thermal food processing has been challenged with the use of innovative approaches like microwave and radio frequency applications for reducing energy requirements and increasing quality, conventional approaches still keep their significance as major pillars of the food industry. Additional concerns are food safety (the increase of food-borne outbreaks in the few decades are significant issues for process design) and sustainability. All of these coincide with the current challenges of environmentally friendly processing.

To satisfy all these concerns, mathematical modeling-based virtualization for process design and optimization is required. With the introduction of Industry 4.0, key components of machine learning, artificial intelligence, the internet of things, and others are expected to combine for sustainability and improved process design. While the computation model describes the process, additional components might be used for an efficient design and optimization.

Therefore, the objective of this study is to present computational examples in the view of food processing for comparisons between conventional and innovative approaches. A detailed research-based summary for process design and optimization for scaled-up industrial processes, based on physics-based mathematical modeling virtualization, will be introduced.

For this purpose, the following outline will be used:

- Conventional processes for thermal processing (canning and aseptic processing),
- Innovative approaches for thermal processing (focusing on microwave and radio frequency),
- Process design – optimization using mathematical modeling, and
- Comparisons of conventional and innovative processes (for thawing and pasteurization – sterilization).

With the challenges of the food industry for sustainability and improved process design, novel technologies are expected to play a more significant role. Computational modeling and virtualization are therefore presented as important approaches for designing efficient sustainable processes.