Unfold the limitation of ohmic heating by mechanistic modelling

FEYISSA A. (1)
1 Research Group for Food Production Engineering, National Food Institute, Technical University of Denmark, 2800 Kgs., Kgs. Lyngby, Denmark

Abstract
Ohmic heating (OH) is one of the emerging technologies allowing volumetric and rapid heating of the product and potentially solving the problem of heat transfer in solid and semi-solid foods. However, particularly, for food products, not only heterogonous in nature but also changes their physical properties drastically during heating is unpredictable. This is a big challenge that limits its application for solid or semi-solid such as meat, baked goods, plant-based food, etc.
This study focuses on a deep understanding of OH processing heterogeneous and changes material properties (physical properties) dramatically during processing. For better understanding and exploring beyond the boundary of its current limit, a mechanistic mathematical model that describes phenomena such as heat and mass transfer (multi-phase, e.g., gas and liquid), electric field, evaporation, and dynamical changes of the physical properties have been developed. The model considers the discrete local variation of material properties. The newly established model is unique to address the challenge of ohmic heating. Model equations (systems of partial and ordinary differential with constitute equations) were solved numerically using COMSOL multiphysics® version 6. Using the modelling, e.g., the pore formation during the processing of meat, plant-based, and baked goods and its effect on the performance of baking/cooking have been investigated. By modelling, new insights have been obtained that shed on how to improve the process performance. The approach has been tested with case and a good agreement between model insights (mechanistic model) and experimental observation has been obtained. At the conference, the mechanistic model, newly obtained insights, and how these can be used to resolve some of the limitations will be discussed. The obtained fundamental understanding can be used for different solid/semi during electric-based processing of solid or semi-solid food.