Contribution ID: **786** Type: **Poster (+) Presentation**

Microscale modeling of thermo-hydro-mechanical behavior of fruit tissue during drying

Tuesday, 1 June 2021 10:00 (1 hour)

The deformation of fruit tissue caused by drying typically results in consequent quality loss. To better understand the mechanism of heat and moisture transfer, a coupled thermo-hydro-mechanical model was developed at microscopic cell scale. Pear was chosen as the research object as this fruit suffers from great shrinkage after drying. A 2D geometric model of cortex tissue was obtained by a virtual fruit tissue generator that is based on cell growth modeling. The distribution of temperature and moisture in tissue cells were predicted using transport laws, and the different physical properties of the microstructural components were obtained experimentally or from literature. An equivalent microscale cell model that incorporates the dynamics of mechanical deformation of the cellular structure was implemented. It can not only predict the heat and moisture transport in tissue cells, but also obtain the deformation characteristics of different regions in the tissue, which further reveals the thermo-hydro-mechanical coupling mechanism during drying process. The results showed that the pore size of tissue cells gradually decreased with time. At a drying temperature of 70℃, the volume shrinkage ratio of tissue cells was about 50% after reaching a steady state. The intercellular spaces of tissue can be regarded as closed pores in porous media, and stress concentration tends to occur near these positions. A sensitivity analysis of water permeability, thermal conductivity of cell membrane and elastic modulus of cell wall on the tissue deformation showed that, the cell membrane permeability has a greater impact on the deformation during drying within a certain range of changes. It will then become feasible to evaluate measures to improve the quality of fruits and vegetables during drying using this model in a multiscale modeling framework.

Time Block Preference

Time Block A (09:00-12:00 CET)

References

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Primary author: Dr MOU, Xinzhu (Southeast University)

Co-author: Prof. CHEN, Zhenqian (Southeast University)

Presenter: Dr MOU, Xinzhu (Southeast University)

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