Food Cooking Process. Numerical Simulation of the Transport Phenomena

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Abstract

Aim of the study is to determine the influence of some of the most important operating variables, especially humidity and temperature, of drying air on the performance of cooking process of pork meat.

Cooking can be considered as simultaneous heat and mass transfers between food product and oven ambient. Modeling of cooking includes heat convection, food surface water evaporation, internal heat conduction. This work evaluates the dependence of temperature and water content on process time, during cooking of meat pieces of two different regular shapes. The process is simulated using finite elements software COMSOL Multiphysics®.

The proposed model considers two geometries: cylindrical and parallelepiped, with fixed physical properties and convective boundary conditions. The basic objective of work is to develop a numerical model that allows the estimation of the effective moisture diffusivity and the mass transfer coefficient at the surface of food products during cooking process.

The model takes into account the diffusion phenomena that take place inside the food and exchange phenomena that are established between product and environment. The geometry of the model is parametric, so you can easily vary the size of the sample. This allows to obtain curves possibly time-concentration of water within the product in function of the dimensional characteristics and constitutive of the same product.

Temperature and water content distributions as function of position and time were predicted. Such model can be helpful in understanding the physics of meat cooking, and can be used to improve prediction of temperature and moisture loss. A finite element model, which considered one-way coupled simultaneous heat and mass transfer, was established to describe convection cooking of pork meat. The model was used to predict transient temperature and moisture distributions inside the product, as well as transient cooking yield of meat samples during cooking.

With future incorporation of physicochemical models and bacterial lethality models, such a model could be further used to optimize cooking conditions, procedures and facilities for the control of food quality and safety. It is expected in the future to create a model for cooking pork meat in a microwave oven and compare it with the results obtained for the classical convection oven.