Multiphysics Modeling of Microwave Heating of a Multiphase Model Food System

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Introduction
- Non-uniform heating is a critical issue in microwave heating of microwaveable food products.
- Computer simulation of microwave heating process is a promising tool to help food scientists in developing food products, packages and cooking instructions.

Objectives
- Develop a multiphysics model coupling physics of electromagnetic heating, heat, mass, and momentum transfer to predict microwave heating performance of a 19 oz tray of fresh mashed potatoes on a rotating turntable.

Model Development
- Geometry incorporated complex features such as crevices and metal bumps was created.
- Simulation performed using a partially coupled approach.
- A comprehensive 3-D multiphysics model coupling electromagnetic heating, heat, mass, and momentum transfer was created.

Materials and Methods
- Temperature-dependent dielectric properties were measured using a coaxial probe method.
- Mashed potatoes heated for 3 min on a rotating turntable in a 1100 W microwave oven.
- Thermal imaging camera used for recording top and bottom layer thermal images.
- Fiber-optical sensors used for recording point temperatures.

Results
- A comprehensive 3-D multiphysics model coupling electromagnetic heating, heat, mass, and momentum transfer was developed.
- Simulation of microwave heating of rotating object was performed using MATLAB - COMSOL interface.
- Simulated and experimental results are in good agreement.

Conclusion
- A comprehensive 3-D multiphysics model coupling electromagnetic heating, heat, mass, and momentum transfer was developed.
- Simulation of microwave heating of rotating object was performed using MATLAB - COMSOL interface.
- Simulated and experimental results are in good agreement.

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