# Ohmic heating for process improvement  Experimental and computer simulation analysis of recent applications in foods of systems working at high frequencies

**LLAVE Y. (1), FUKUOKA M. (1)**
1 Tokyo University of Marine Science and Technology, Tokyo, Japan

Recently, several emerging technologies in the thermal processing field of foods have been developed and are being progressively applied with the objective to produce safe and high-quality products. Although, ohmic heating (OH) is one of these technologies, there are few studies regarding applications of OH of food products at high frequencies. This work introduces original and recently published OH applications on foods at high frequencies, electrical conductivity data of the treated foods, and computer simulation models of the used systems to achieve uniform heating with the target to contribute with the growth of this technology in the food processing sector.
In particular, the ohmic cooking of rice, the pasteurization of eggs liquids in static, agitated, and continuous systems, and the heating process of meat and fish were evaluated. The electrical conductivities (EC) in the range of 50 Hz to 20 kHz were measured by a LCR meter and by monitoring the voltage and ampere in the temperature range of thawing and heating operations. The effect of temperature and frequency but also the composition of the foods, the direction of the muscle related to current flow, and the presence/absence of substances that might block the flow of the current such as membranes, fat layers, and skin were evaluated. COMSOL Multiphysics was used to construct 3D models to analyze the heat generation, temperature distribution uniformity, and to fine-tune processing parameters.
OH applications at high frequencies resulted faster and more uniform in temperature distribution than conventional OH process at 50 or 60 Hz, basically due to the higher EC values observed at higher frequencies. A fine-tune of the voltage resulted necessary for thawing applications to avoid runaway problems in some areas. Computer simulation of the processes helped to find hot/cold spots specially at higher electric field strength values in liquid applications, and to evaluate the effect of protein denaturation on the quality attribute changes in meat and fish samples. The data described herein could be of potential value in industrial applications for a better design of OH systems.