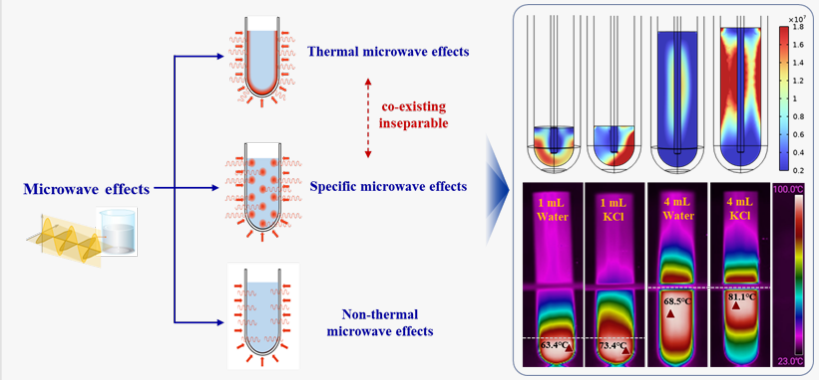
Looking into specific microwave effects and reliability concerns

GA, UNITED STATES, January 21, 2025 /EINPresswire.com/ -- Researchers investigated the microwave heating characteristics in a single-mode microwave system by using Multiphysics numerical simulations. The key findings provided a theoretical basis for comprehending microwave-heating processes in single-mode reactors and clarify the common microwave-specific effects encountered in laboratory settings.



How the solution volume and type affect the microwave heating.

Domestic microwave ovens are one of the most familiar electrical appliance among households worldwide. In the world of science, however, the common use of multimode microwave cavities for small-scale food chemical reaction research (< 5 mL) is not appropriate, especially in terms of the interactions between the microwave field and food components, as well as the controlled chemical or enzymatic reactions.

To that end, in a study published in the KeAi journal Food Physics, a group of researchers from the China investigated the microwave heating characteristics of liquid in a single-mode microwave system. They used multiphysics numerical simulations to provide a theoretical basis for comprehending microwave-heating processes in single-mode reactors and clarify the common microwave-specific effects encountered in laboratory settings.

“Microwave heating is one of the most significant food-related physical-field processing technologies, possessing wide application potential in the food industry and for scientific research. An in-depth understanding of microwave effects and the realization of efficient and uniform heating processes are prerequisites to ensure the rationality of scientific research,” explains senior author, Daming Fan, a professor in food science and technology at Jiangnan University. “However, the underlying phenomena and factors determining the successful application of single-mode microwave heating technology in food science are not widely understood among food scientists.”

The study team found that both the heating rate and uniformity were significantly influenced by the solution volume and type. The presence of abnormal convection resulted in higher temperatures in the upper layers of the solution, potentially affecting protein thermal aggregation processes. Therefore, several phenomena and factors that must be considered before drawing any conclusions, such as an unusual temperature gradient, heating volume, or material properties and the characteristics of single-mode microwave systems.

“Our findings allow us to better understand the selection of single-mode microwave heating methods for specific food science research, heating uniformity and other reliability concerns,” says lead author Xidong Jiao. “In particular, they provide a theoretical basis for studying the chemical reaction processes of food components in a single-mode cavity and for achieving relatively uniform microwave heating while exploring reaction mechanisms.

The researchers hope that their results would encourage scientists to continue investigating the efficient utilization of microwave heating in food science and contribute their inspiring innovative approaches towards a common understanding of the microwave effects.

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