Proposal of a new meat cooking method using High-intensity focused ultrasound(HIFU)

Ayaka Tsutsui

In this study, we proposed a cooking method that uses HIFU (High Intensity Focused Ultrasound) to locally and selectively heat chicken thighs to enrich the selection of heated parts of chicken thighs. We also proposed to customize the design of the food surface by drawing letters or line drawings inside, on the cross section, or on the surface of the chicken thigh. Conventional cooking methods such as baking, boiling, and steaming can only heat food from the surface, and heat may not be evenly transferred to the interior of the food, or the interior of the food may not be completely heated. To solve these problems, ultrasonic waves are irradiated directly onto the food material, making it possible to heat not only from the surface of the food material but also locally and selectively inside the food material.

To focus the ultrasound on the point in the chicken thigh to be heated, a single-element HIFU is used in this study; HIFU refers to high-density focused ultrasound, an ultrasound device that can focus on a specific point in the tissue by generating high-frequency sound waves. In this study, the phase of HIFU is controlled to maximize the energy density in the focal region where ultrasound waves are focused, causing a temperature increase above a predetermined temperature that affects the tissue. This study applied the phenomenon of ultrasound thermal coagulation to the cooking of meat and proposed a new cooking method.

In this study, experiments were conducted in water using a 2 MHz HIFU. The results showed that temperatures of more than 70°C were emitted at the focal distance of the HIFU, 51.5 mm. When the center of the chicken thigh was irradiated according to the focal distance of the HIFU, only the contents were successfully heated locally without affecting the surface tissues of the chicken thigh. For the design of the food surface, the xyz stage was used to move the meat and draw arbitrary characters and line drawings on the food surface. the xyz stage was implemented in Python, and the placement of the meat was optimized so that the characters would not bleed even on the food surface. In the future, we hope that the evaluation based on the ease of design, comparison of designed and non-designed meat, and customization of chewiness will bring us closer to the practical application of cooking methods that enrich the selection of heated parts, and contribute to increasing the willingness of cooking and food lovers to purchase ultrasonic cooking equipment, and further development of the cooking and food industries. We hope that this will contribute to the further development of the cooking and food industries.

（Adviser: Norihiko Uda）