Optimization of the Hot-Fill-Hold Method for the Pasteurization of Glass Containers Filled with Acid Viscous Foods

MORAWICKI R. (1), SCHMALKO M. (2), ALBANI O. (2)
1 Johnson and Wales University, Providence, United States
2 Universidad Nacional de Misiones, Posadas, Argentina

The hot-fill-hold process is a method for pasteurizing the container and closing when filled with acid foods to create a shelf-stable product after reaching commercial sterility. The process consists of filling containers with hot product, capping the container, and inverting it to pasteurize the container and closing with the heat provided by the product. Current hot-fill-hold processes use conservative high fill temperatures, typically 81-85ºC, that often unnecessarily overheat the product. This research aimed to determine the optimal fill temperature for containers filled with a viscous product that will heat the container primarily by conduction. For this purpose, 453, 680, and 907 grams jars were filled fully (no head-space) with tomato paste at temperatures of 87.8, 82.2, 76.7, and 71.1ºC and capped with metal lids. The containers were not inverted after filling and capping to simplify the experimental setup. The jars were furnished with thermocouples attached to the interior walls and connected to a data logger to record the internal time-temperature history of the walls, bottom, and closing area. The time-temperature history was used to calculate the cumulative lethality on the interior jar surfaces as the container initially heats up and then cools down using the finite-difference method. To estimate the temperature in different container parts, the container was divided into cylindrical finite nodes with a ?r radius and a ?z height. The container walls and bottom were considered independent nodes. An energy balance was performed in each node, assuming the radial and axial heat transfer from neighbor nodes. The cumulative lethality was calculated using the General Method with an F-value of 1.2 min at 71.1ºC (z-value=10.8ºC) for products with a pH of 4.1 or below and of 5.6 min at 71.1ºC (z-value=9.5ºC) for products with a pH above 4.1. These parameters are sufficient to achieve a 5-logarithmic reduction in *E. coli, Salmonella spp.,* and *Listeria monocytogenes*, which are the most common pathogenic targets. Results show that the target F-value can be reached at lower fill temperatures than traditionally used without compromising product safety. Moreover, this research will provide process authorities with a valuable tool to recommend filling processes.