

Modelling bacteria inactivation during the steaming process: application to Cambodian p pasteurization

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Cambodian pâté is a popular food that can be found in every market throughout the country but its consumption is associated with a substantial proportion of food-borne illnesses. Traditionally this product is made by blending meat with a variety of ingredients and cooked using steam. A common issue found in the steaming process is the heterogeneous temperature distribution, which limits microbial inactivation within the product. The present work aims to model heat transfer and microbial inactivation during the pâté steaming process and to validate them by challenge test experimentations.

Numerical simulations of the steaming process were performed with COMSOL® Multiphysics 6.0. The remaining bacteria after treatment were assessed from a microbial inactivation model for three key bacteria: *Listeria innocua*, *E. coli* and *Salmonella typhimurium*. Model validation was done with an innovative challenge test design where the inoculated pâté is loaded into inoculum tubes placed at the center and periphery of a cylindrical cell which contains the raw pâté (TB zone for the bottom of the cell and TH for the top). Temperature profiles were recorded for each zone throughout the treatment and the pâté sample was heated until the temperature at the center reach 55°C, 57.5°C and 60°C. The inoculum tubes were then cooled down immediately and the remaining bacteria were quantified.

When the temperature of the steam is 98°C, it took 16 min, 24 min, 25 min to increase the temperature at the center from around 10°C to 55°C, 57.5°C, 60°C respectively. The model depicts the temperature gradients between the cold and hot spots decreasing along with the increasing temperature at the center of the sample. After 57.5°C treatment, remaining bacteria at the center (TB and TH) were evaluated around 3 to 4 log cfu/g (initial amount of 7 log cfu/g). An undetectable amount of bacteria was obtained for treatment higher than 60°C for the three bacteria.

The experimental results were found in agreement with the modelling approach and highlighted the suitability of the suggested innovative cell design to support the setting of heat treatment parameters as well as the benefit of combining heat transfer model and microbial inactivation.