Predicting outgrowth and inactivation of Clostridium perfringens in meat products during low temperature long time heat treatment - DTU Orbit (09/11/2017)

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OBJECTIVE

Sous-vide cooking and molecular gastronomy has started a wave of experimenting with Low Temperature Long Time (LTLT) heat treatments. Heat treatments, at temperatures as low as 50°C, have been suggested by celebrity chefs. LTLT treatments often take hours to reach to the final core temperature and Cl. perfringens is, therefore, of special interest as it may outgrow during the coming up time and cause food safety problems. This study was undertaken to set up a predictive tool to establish the outgrowth potential of C. perfringens in LTLT meat products as a function of the applied heating profile.

METHODS

Challenge tests were performed at two dynamic temperature profiles (fast LTLT, 2.6 h from 10 to 53°C, and slow LTLT, 3.8 h from 10 to 53°C) with three types of inoculums (spores, heat-active spores and vegetative cells) of Cl. perfringens 790-94 in two different types of meat pork (pH 5.6) and chicken (pH adjusted to 6.8). Challenge tests representing LTLT treatments of beef were collected from the literature. The obtained growth data were used for evaluation of three different growth models originally validated for prediction of growth during cooling (Le Marc et al. 2008, Juneja et al. 2011, Jaloustre et al. 2011). The data in inactivation phase were used for evaluation of three inactivation models generated by Foegeding and Busta (1980), van Asselt and Zwietering (2006) and Jaloustre et al. (2012). Finally, a new growth model, derived from the model structure of Le Marc et al. (2008), was developed from literature data (215 isothermal growth data), and was combined with a linear inactivation model developed from data at 53°C from this study for completely predicting fate of Cl. perfringens during LTLT treatment.

RESULTS

Very short lag times were observed in most of the challenge tests, especially in high pH chicken. By using the acceptable prediction zone method, performance of literature models was evaluated and none of the growth and inactivation models could successfully predict the growth or inactivation of Cl. perfringens for the LTLT conditions of our challenge tests. Therefore, a new growth model and a new inactivation model were developed and combined to predict the overall fate of Cl. Perfringens during LTLT profiles at 53°C. However, predicted lag time was still much longer than the observed lag time in our challenge tests, which caused a general underestimation of growth giving rise to overestimation of inactivation in particular for chicken. To obtain more precise predictions, an RLT of 2-3 was recommended for chicken, independent on type of inoculums, and for vegetative cells in pork. For spores and heated spores in pork the increase of Cl. perfringens during LTLT coming up time never exceeded 1 log10-unit.

CONCLUSIONS AND IMPACT OF THE STUDY

A model combining both growth as well as inactivation for prediction of fate of Cl. perfringens during the LTLT treatment was developed. The model is the first predictive model specifically designed for LTLT treatment of meats. Very short lag times were observed during LTLT treatments, which were not observed in isothermal or cooling conditions previously. The reason for short lag time during slowly increasing temperature conditions, and how to predict it, should be interesting for future studies.

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