Application of the thermal inactivation model to model risk to human health from consumption of VTEC O157 in beef burgers

Area of research interest: Foodborne pathogens
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Conducted by: RIVM – Centre for Infectious Disease Control, Netherlands

Background

In November 2014, the previously developed APHA quantitative risk assessment for estimating the impact on human health from the consumption of VTEC O157 within a beef burger and other food products (Kosmider et al., 2010) was updated to consider a recent increase in the consumption of rare burgers. Within the risk assessment, the inactivation of VTEC O157 during cooking is modelled using a relatively simple approach (see Cassin et al., 1998). Specifically, the log reduction of VTEC O157 is modelled as a function of the internal temperature without taking into consideration the size of the burger or the variation in temperature within the burger as an external temperature is applied.

To address this, a thermodynamic inactivation model developed by the RIVM and previously used within an EFSA funded risk assessment for Salmonella in pork products (Anon, 2007) has been used to better refine the characteristics of the cooking process and resulting impact on VTEC O157 in beef burgers.

Research Approach

The purpose of this study was for RIVM to investigate the impact of heat transfer within beef burgers of different sizes on the log inactivation of VTEC O157.

The RIVM thermodynamic model divides the burger into a number grid cells dependent on its thickness and width and simulates the heat flow through these cells as it is cooked and the resulting inactivation of bacteria within each cell. The outputs from the thermodynamic model include the time to reach a desired internal cooking temperature and the overall inactivation of VTEC O157 within the burger.

A number of scenarios were tested to reach different cooking preferences of the consumer. The thermodynamic inactivation model is able to show the time taken to reach the preferred cooking style with a defined internal temperature. The following variables were tested to identify the time taken to reach these scenarios:

- Thickness / height of the burger – 1 cm for small burgers, 2.5 cm for regular burgers and 5cm for gourmet burgers

- Cooking Preference – rare (54.4°C), medium (62.7°C), well done (68.3°C), well done +2 minutes, 4 log inactivation and 6 log inactivation

Following this analysis, the findings of the inactivation of VTEC O157 across different cooking preferences are then input to the APHA risk assessment model to provide the number of human infections of VTEC O157 per 100,000 servings.

Results

This work has applied the outputs of a more comprehensive cooking model for inactivation of VTEC O157 within a variety of different sized burgers within a previously developed risk assessment model. The models suggest that there is an influential relationship between burger size, internal temperature and cooking duration on the inactivation profile of VTEC O157 within the burger and the subsequent risk to public health. In conclusion, regardless of burger size, consumption of rare burgers results in greater infections with VTEC O157 compared to medium and well-done burgers. Furthermore, cooking a burger so it is well-done (i.e. internal temperature of 68.3ºC) plus extra 2-minutes results in complete inactivation and therefore no predicted cases of VTEC O157 illness in humans.

The results are based on the model assumptions and inputs and therefore the absolute value should be used with caution. There could still be a theoretical risk from consuming such burgers and therefore the risk should not be considered zero but rather negligible.

Research report

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