Risk to human health from consumption of VTEC O157 in beef burgers

Area of research interest: Foodborne pathogens
Study duration: 2014-10-01
Planned completion: 1 November 2014
Project code: FS101124
Conducted by: Animal and Plant Health Agency (APHA)

Background

A quantitative risk assessment model has been developed which estimates the impact to human health from the consumption of VTEC O157 within a beef burger and other food products. The model simulates the prevalence and levels of VTEC O157 through the production process from the abattoir through to human consumption. The model provides an estimate of the prevalence of contaminated beef burgers within 100,000 servings and the corresponding number of human illnesses given the estimated amount of VTEC O157 consumed within a contaminated burger in the domestic home setting.

This model was developed by AHVLA (now APHA) in 2008 as part of an EU Camp-EC Net project and aimed to use the best available data. However, cooking preferences and consumption patterns have changed since the model was developed; for example there is an increasing trend in consuming rare or medium cooked beef burgers.

We commissioned the APHA to update their model with more recent cooking data and refine the model estimates for VTEC O157 levels in rare and medium cooked beef burgers.

Research Approach

The purpose of the study was for the APHA to update the parameter estimates used in the model which was considered influential in determining the impact to human health from the consumption of VTEC O157 within cooked or raw burgers. These were:

- The size of the burger produced
- The amount of the burger consumed (consumption patterns), and
- The style of cooking (e.g. rare, medium, well-done)

Each parameter is considered in turn in terms of updating the model; all other parameters remain unchanged from the original model.

In addition to the revised estimates for the cooking styles, at the our request, two additional log reductions were considered: a 4 log and 6 log reductions respectively.

Given the revision to the parameters as outlined above, several scenarios were considered namely:

- All burgers well done
- All burgers medium
- All burgers rare
- All burgers reduced by 6 logs during cooking
- All burgers reduced by 4 logs during cooking

For each scenario, three further scenarios were considered regarding burger size consumed namely, big burgers only (113g), small burgers only (85g) and both sizes (big and small 50:50). This yielded a total of 15 different scenarios.

In addition, a further scenario of consuming burgers (big and small) cooked using either of the preferences (well-done, medium and rare burgers) according to the revised frequencies outlined above was considered.

Results

As expected, the model predicts that consumption of rare burgers results in the highest number of human illness per 100,000 servings (average = 19) compared to medium (average = 11.3) and well done (average = 8) burgers. More specifically, on average, there is a 41.25% and 137.5% increase in the mean likelihood of infection for medium and rare burgers respectively, compared to a well-done burger. Furthermore, a burger that achieves only a 4 log reduction is 203% more likely to cause an infection compared to one that achieves a 6 log reduction (which is assumed to be the desired reduction).

A key consideration here is the difference between well done burgers and burgers achieving a 6 log reduction after cooking. Assuming that both are comparable (i.e. a well done burger should achieve a log reduction of a similar magnitude), the well done category highlights that, in practice in the home, cooking burgers to ‘well-done’ is unlikely to achieve the same log reduction. This is a result of the variability of cooking practices in the home with not all well done burgers reaching 70°C (only 19.8% of burgers reach the required temperature). Further, importantly, the model does not account for the duration of cooking.

Within the combined simulation, it was assumed 87.9% of burgers are well done, 8.8% medium and 3.3% are rare. The corresponding mean number of cases per 100,000 servings was 9.3. This compares to 8 infections estimated in the original model. This increase in the number of infections in the revised model is not unexpected given the increase in the frequency to eat rare burgers compared to the original model.

Following this study, our organisation commissioned RIVM to undertaken a further thermodynamic modelling study in early 2015 as this work did not include time and temperature parameters.

Research report

England, Northern Ireland and Wales

PDF
[View FS101124 - Summary report: Risk to human health from consumption of VTEC 0157 in beef burgers as PDF(Open in a new window)] (551.1 KB)

England, Northern Ireland and Wales

PDF
View FS101124 - Appendix 1 as PDF(Open in a new window) (241.89 KB)

England, Northern Ireland and Wales

PDF
View FS101124 - Appendix 2 as PDF(Open in a new window) (859.29 KB)