Assessing the impact of heat treatment on antimicrobial resistant (AMR) genes and their potential uptake by other ‘live’ bacteria

Area of research interest: Antimicrobial resistance
Study duration: 2020-11-01
Project status: Completed
Project code: FS307036
Conducted by: TEC Partnership
Date published: 25 August 2021
DOI: https://doi.org/10.46756/sci.fsa.oxk434

Background

Addressing the public health threat posed by AMR is a national strategic priority for the UK, which has led to both a 20-year vision of AMR and a 5-year (2019 to 2024) AMR National Action Plan (NAP). The latter sets out actions to slow the development and spread of AMR with a focus on antimicrobials.

The NAP used an integrated ‘One-Health’ approach which spanned people, animals, agriculture and the environment, and calls for activities to “identify and assess the sources, pathways, and exposure risks” of AMR. The FSA continues to contribute to delivery of the NAP in a number of ways, including through furthering our understanding of the role of the food chain and AMR.

Thorough cooking of food kills vegetative bacterial cells including pathogens and is therefore a crucial step in reducing the risk of most forms of food poisoning. Currently, there is uncertainty around whether cooking food is sufficient to denature AMR genes and mobile genetic elements from these ‘dead’ bacteria to prevent uptake by ‘live’ bacteria in the human gut and other food environments - therefore potentially contributing to the overall transmission of AMR to humans. This work was carried out to assess these evidence gaps.

Objectives and approach

This review of the scientific literature was carried out to improve our knowledge of the impact of heat treatment (cooking) on AMR genes and their potential uptake by other bacteria. It is important to understand whether cooking food to eliminate bacterial contamination can also induce sufficient damage to AMR genes to prevent their uptake by surrounding viable bacteria present in other settings, including the human gut.

The work considered the effects of different cooking methods on AMR genes and their transfer from food to humans, analysing whether the use of milder cooking methods compared to thorough cooking (70°C for 2 mins or equivalent) encourages more effective transfer of AMR genes via food.

The study involved:

- A structured literature search of appropriate bibliographic databases and sources, ranging from 1990 to the end of 2020

- Screening of articles for relevance, prior to data extraction and analysis
- The extracted data from articles was synthesised into a formal review report in order to establish what existing data and understanding there is on the impact of heat treatment on AMR genes that may be present in heat-killed foodborne bacteria and their potential uptake by other ‘live’ bacteria in the human gut and other foods.

Results

This critical review confirmed:

- AMR bacteria are no more heat-resistant than non-AMR bacteria. Therefore, cooking (70C for 2 mins or equivalent) is sufficient to kill AMR bacteria that may be present in foods
- The evidence as to whether intact and functional AMR genes persist after heat treatment is sparse. Only four published papers were identified but these were not comparable
- Whilst the published evidence is very limited, the studies identified do provide some evidence that AMR genes may potentially persist in cooked foods following heat treatments. Though detectable, these genes may not be functional
- If AMR genes are not sufficiently damaged during heat treatment, it is possible that genes could be subsequently taken up by other bacteria, but the occurrence of this transfer is expected to be rare
- No papers were found which demonstrate that AMR genes from heat-treated AMR bacteria could be taken up by other ‘live’ bacteria in the human gut
- There is currently a lack of evidence to determine if there is a risk to human health
- Uncertainties remain in this research area which may warrant further investigations.

Report

PDF
View Assessing the impact of heat treatment on antimicrobial resistance genes and their potential uptake by other ‘live’ bacteria as PDF(Open in a new window) (811.87 KB)