It’s the small things in life: Part 1 – Why cook your chicken?

Teacher notes

The issue

The Earth’s resources are limited, but the human population is growing fast. How can we ensure food security – adequate safe, healthy food – for everyone?

This two-part investigation can serve as a lead-in to discussions on the efficiency of eating meat and on the components of a healthy diet. Food safety and some basic microbiological techniques are introduced. Students examine the effect of temperature on the viability of yeast, before applying this to the microbial load on the food they eat. These activities can act as an introduction to the microbiomes (the microbes that live in a given ecological niche, and the sum of their genomes) of different species and their significance in human health and sickness.

Introduction

Research into the human microbiome is revealing its importance in maintaining health. Similarly, the chicken microbiome contributes to chicken wellbeing. However, if microorganisms from the chicken gut microbiome enter the human gut microbiome, they may cause food poisoning – stomach cramps, diarrhoea and, in vulnerable people, serious illness and death.

In these two practical sessions (part 1 and part 2), students investigate the importance of cooking chicken well using yeast as a proxy for the chicken microbiome.

This topic can act as a starting point from which other aspects of food, environment and health can be examined. Students can consider the problem of food poisoning caused by *Campylobacter* in the UK and elsewhere. This investigation will help them understand why it is so important to cook chicken well. It can also lead into an understanding of wider issues. For example, as the incomes of the poor rise in many countries, more meat is eaten, requiring more resources (land and water) per kilogram of protein than the same amount from vegetable sources. Chickens are raised and eaten in many societies, and discussion of the environmental impact of small- and large-scale poultry farming can illustrate the effects that humans’ food choices have.

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Research informing the investigation

This set of activities draws on several current areas of research interest. One is the importance of the human microbiome in health and wellbeing, and the way disturbances in the microbiome are linked to disease. Another is the presence of *Campylobacter* as a commensal organism (one that benefits from living with another organism without causing benefit or harm to the other organism) in the healthy microbiome of chickens, the ways in which it is transmitted from the chicken that we prepare and eat to our guts, and effective ways of controlling food-borne diseases such as *Campylobacter* on a global scale. For their advice, we are indebted to:

- Professor Martin CJ Maiden, University of Oxford (population biology and evolution of bacterial pathogens)
- Professor Mike Wilson, University College London (human microbiome; advisor to the Eden Project).

We are indebted to SSERC and CLEAPSS for their help in developing the practical activities.

Assumed prior learning

- Aseptic techniques for culturing microorganisms – or use the practical activities as a vehicle for teaching these techniques.
- Knowledge of gut microorganisms is helpful, as is knowledge of the transmission of disease and methods of preventing spread, but equally these activities could be used to introduce many of these ideas to students.

Learning objectives

- Explain the use of aseptic techniques in culturing microorganisms.
- Recognise the effect of temperature on microbial viability.
- Recognise the microbial contamination of chicken meat as one way in which communicable diseases are spread.
- Explain the effect of cooking on microbes as a way of preventing the spread of communicable diseases transmitted via raw or undercooked meat.

Activities

Aim

The aim of the practical investigation is to explore the effect of temperature on the viability of microbes and to link this to the importance of cooking chicken thoroughly to minimise the likelihood of food poisoning. In this investigation students will use yeast as a safe proxy for the chicken microbiome.

The investigation is part of a wider set of activities looking at chicken consumption and husbandry worldwide. It comes in two parts; this is part 1.

Introductory activities

The student activity sheet contains some background information that explains the real-world context and the purpose of the practical investigation. This sheet could be provided as a homework reading task before the lesson for some classes. The investigations can also be contextualised in starter activities (see the presentation 'It's the small things in life' and the 'Delivery guidance' provided on The Crunch website, **thecrunch.wellcome.ac.uk/schools**), so if you prefer you can hand out the student activity sheet in the class and refer students directly to the practical instructions. The presentation supplied on The Crunch website prompts exploration of the importance of chicken as a relatively cheap, available and tasty source of protein eaten all over the world.

Chickens are also a source of many cases of food poisoning, usually as a result of poor food hygiene (often in the home). Of the more than a million cases of food poisoning in the UK every year, half are from identified pathogens, of which *Campylobacter* (specifically, *Campylobacter jejuni* and *Campylobacter coli*) cause the largest number of cases – 280 000 each year. The most common source is chicken, but it is also commensal in the guts of cattle and sheep. Two video clips are provided on The Crunch website describing DEFRA-supported research: 'Chickens and *Campylobacter*: The farm story' and 'The lab story'.

Students may have heard of and ask about salmonellosis. *Salmonella enterica* infection is regarded as a disease in chickens, and in the UK birds are vaccinated against this organism. Outbreaks of disease are usually linked to imported meat or eggs from unvaccinated flocks, and are now rare. Globally, though, *Salmonella enterica* is still a problem and another major cause of diarrhoeal diseases.

Use the infographic from the UK Food Standards Agency (**www.food.gov.uk/sites/default/files/campylobacter-infographic.pdf**, reproduced in the presentation) to prompt discussion of food poisoning. Explain to students that microbes such as *Campylobacter* do not cause disease in chickens, and that some of our human gut microbiome could make chickens ill. Ask how microbes from chicken get onto the meat, how they are spread to people and how this might be prevented. Introduce the practical investigation.

On The Crunch website (**thecrunch.wellcome.ac.uk/schools**) you will find a video clip ('Chicken and cross-contamination') showing scientists investigating the microbiome on pieces of raw and cooked chicken. The investigation described below follows a similar protocol, using yeast for safety, in order to show the effect of thorough cooking. You can show the video as an introduction to the practical work. At the end of the investigation (part 2), students can compare the results of the two investigations to clearly understand the link between the experiment in the video and their own use of yeast as a proxy.

Important: Emphasise the need for good aseptic techniques and hygiene including hand-washing before and after carrying out the practical.

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Practical investigation: Heat treatment of microorganisms

Safety

Carry out a risk assessment with the students. Ask what hazards they can predict and how to control them.

Good hygiene is vital when handling microorganisms. Wash your hands thoroughly with liquid soap before and after the practical work.

Wear eye protection.

The work should be carried out over an impervious surface, which is wiped down before and after the practical with a fresh 1% bleach (sodium hypochlorite) disinfectant solution.

After the first practical session, used disposable loops should be soaked in 1% Virkon® solution for at least 24 hours before disposal.

Never open a petri dish (agar plate) once you have added the microorganisms and sealed it. All plates should be autoclaved before disposal after part 2 of this investigation is complete.

Clean up all spillages and disinfect with 1% Virkon® solution immediately.

Incubation temperature must not rise above 30°C.

Advice on the methods used here is available on the websites of CLEAPSS (**www.cleapss.org.uk/**) and SSERC (**www.sserc.org.uk**/). In Scotland, schools must follow the guidance in: *Materials of Living Origin – Educational Uses: A Code of Practice for Scottish Schools and Colleges* and *Safety in Microbiology: A Code of Practice for Scottish Schools and Colleges*. These are available for free download from the SSERC website. The Microbiology Society offers safety guidelines for schools on its website:

www.microbiologyonline.org.uk/teachers/safety-information.

The practical investigation is split into two stages. In this first part, petri dishes (agar plates) are inoculated with samples of yeast that have been heated in water baths at different temperatures. Detailed instructions including equipment, safety information and method are in the technician notes and the student activity sheet.

In the second session, described in part 2, students will count colonies on the different plates.

Differentiation

All students can complete this practical, although some will need more support than others. In a class where students have problems plating the cultures, they could be given the plates after incubation simply to collect and analyse the data.

If timetabling allows, you may wish to start the activity the day before by getting the students to make up the yeast suspensions and label them. The technician will then treat the suspensions in water baths and then refrigerate them. In the next lesson on the following day the students can use their now treated suspensions to inoculate plates.

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Additional activities

Additional activities are described in the teacher notes for part 2 of this investigation.

Answers to questions

1. Before: to avoid contaminating plates from your hands. After: to avoid transferring any microorganisms from the sample materials to your mouth.
2. In theory, heat treatment (such as cooking) kills all microorganisms. But although some may be killed at lower temperatures, a higher temperature is needed to make sure that they are all destroyed. (The range of temperatures helps us to understand why undercooked chicken still harbours microbes and can cause food poisoning.)
3. Order from least to most growth: plate treated with sterile water and yeast suspension treated at 70°C, then 45°C; there may be little difference between suspensions treated at 40°C and below.

Research background

A selection of relevant references is listed in the teacher notes for part 2 of this investigation.

Additional web resources on this topic will be found as links on **thecrunch.wellcome.ac.uk/schools**.

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