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

Technician 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 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.

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.

Investigation: Heat treatment of microorganisms

Planning

You will need to prepare poured glucose nutrient agar plates before the planned practical session.

You will need to prepare suspensions of yeast (*Saccharomyces cerevisiae*) about 90 minutes before the practical activity in order to immerse them in water baths for an hour beforehand.

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Safety

Technician carrying out preparation:
The work should be carried out over an impervious surface, which is wiped down before and after the practical with a 1% bleach (sodium hypochlorite) disinfectant solution. A simple way of doing this is to soak a plastic-coated surface (such as a laminated piece of paper) in a tray containing a shallow layer of 1% bleach for 15 minutes, then blotting it dry. After the practical work, the sheet can be returned to the tray, and there is no need to disinfect the bench surface.

You may wish to have a spillage kit at hand during the activity: a screw-capped bottle containing undiluted Virkon® disinfectant and marked with the volume of water required for dilution; a dustpan; paper towels; disposable gloves; an autoclavable, sealable container for sterilisation and disposal of contaminated broken glass.

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

After part 2 of this investigation, all petri dishes (agar plates) must be autoclaved without being opened before disposal.

If making up Virkon® solution from powder or handling large volumes of the solution, wear goggles and rubber gloves.

If excess Virkon® solution is not retained after the session, small quantities should be diluted with copious water and disposed of via a foul water drain. (See the manufacturer's material safety data sheet for more information.)

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/.

Students: Good hygiene is vital when handling microorganisms.

Wash your hands thoroughly with liquid soap before and after the practical work.

Wear eye protection.

Never open an agar plate once you have added the microorganisms and sealed it.

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

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Equipment

From the kit:

- dried yeast
- 4 × sterile swabs per group
- 4 × petri dishes per group (prepare these with sterile glucose nutrient agar)
- chinagraph pencil/marker pen per group
- adhesive tape
- agar granules (100 g, enough for about 200 petri dishes)

You will also need:

- if disposable loops or swabs are used, large beaker or stable container with 1% Virkon® solution in the bottom (deep enough to cover loops) for disposal of loops per group
- access to paper towels and 1% Virkon® solution
- eye protection
- rack and 4 × sterile test tubes/boiling tubes per group
- glucose
- sterile water (steam-sterilised for 15 minutes at 121°C in a pressure cooker or autoclave)
- water baths for the preparation.

Note that if more water baths are available, the teacher may choose to use additional samples treated at other temperatures, in which case each group of students will require a correspondingly greater number of swabs/loops, petri dishes and test tubes.

Preparation

Agar plates

The Microbiology Society's *Manual of Basic Practical Microbiology* describes techniques including pouring plates and can be downloaded (PDF) from **www.microbiologyonline.org.uk/media/transfer/doc/sgm_basic_practical_microbiology_2.pdf**. CLEAPSS *Laboratory Handbook* section 15.2.7 and SSERC's *Safety in Microbiology* Code of Practice are also useful.

Prepare 4 standard sterile petri dishes (agar plates) with glucose nutrient agar for each group, or numbers as advised by the teacher, plus spares. Plates can be made in advance to ensure that they are dry and set – no more than 3 days are needed for this.

To make 500 mL glucose–agar solution (makes 30–40 agar plates), using aseptic technique:

1. Put 500 mL distilled water into a 1 L conical flask and add 20 g dry agar granules and 5 g glucose.
2. Swirl to mix the contents.

3. Slowly dissolve the agar and glucose into solution (cover the flask with a loose foil cap and bring to the boil on a hot plate). The contents do not at this stage have to be totally in solution, but there should be no powder on the sides of the flask, otherwise this will caramelise on autoclaving.
4. Cover the top of the flask with foil and label with autoclave tape.
5. Steam-sterilise at 115°C for 10 minutes.
6. Remove the flask and allow to cool to 50°C.
7. When pouring plates, use a sterile bench area and work near a Bunsen flame to create an updraught and reduce contamination of plates; alternatively do it in a laminar flow cabinet, if available. Keep the flask in a water bath set to 50°C to stop the agar solidifying while the plates are poured.
8. To pour the plates, stack lidded plates in a tower up to four plates high. Lift all the top plates and the lowest lid with one hand and pour the agar into the lowest plate with the other. When the plate is about one-third full (~12–15 mL), replace the lid and stack, then lift again to reveal the next-lowest plate and pour. Continue up the stack. Leave the plates to cool still in the stack.
9. Leave the plates to set.

Further advice for agar preparation is available from **www.microbiologyonline.org.uk/teachers/preparation-of-media-and-cultures**.

Yeast suspensions

Prepare the suspensions about 90 minutes before the class starts. Each group of students will need a set of three tubes of yeast suspension (or four if you have four water baths available; see below). For each set of tubes, disperse 1 g dried yeast in 30 mL sterile water. Distribute the suspension between the sterile tubes.

Set three water baths to ambient temperature/20°C; 45°C, 70°C. Immerse a labelled tube for each group in each water bath for an hour before the lesson. Immediately before the lesson, remove the tubes and put them into a test-tube rack for each group, along with another tube containing 3 mL of sterile water. Students will make up their own control suspension (representing no cooking) from this water and 0.1 g dried yeast.

If more water baths are available, you can use four temperatures (20°, 40°, 60° and 70°C) and provide an additional swab and petri dish for each group.

Heat starts to affect the viability of yeast at about 40°C, so more intermediate temperatures will demonstrate the decline in viability more clearly.

If timetabling allows, the teacher may start the activity the day before by getting the students to make up the yeast suspensions and label them. You will 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.

Incubation after the first practical session

Check carefully that all the plates are securely taped at opposite sides, and add tape if necessary so that students cannot open them, while ensuring that there are gaps to enable air to circulate through the plates so that water can evaporate. Incubate the students' plates at 20–25°C for 3 days. If space is short in the incubator, the plates could be left in a secure, shady, fairly warm place (not above 30°C), or removed from the incubator once growth is apparent and stored securely until the next lesson for that group.

Disposal

The discard jars containing used disposable loops or swabs should be kept secure for 24 hours before the liquid is strained or decanted with care and the contents are wrapped and disposed of with normal refuse. After part 2 is complete (described separately), steam-sterilise all plates for 15 minutes at 121°C in an autoclave without opening them, and dispose of them well-wrapped along with normal refuse.

Method

See the student activity sheet for a description.