

Introduction

In a small study reported in the British Medical Journal [1], only one third of all men and one half of women washed their hands after using the toilet. The most common way microbes are spread is via people's hands. Whilst these microbes are often harmless, they can cause illnesses such as colds, flu, sickness and diarrhoea, as well as spreading infections with more serious consequences such as winter vomiting virus, MRSA, *E. coli* 0157, and *C. difficile* in hospitals. Hand washing is thought to be the single most important thing anyone can do to help reduce the spread of infections. It takes a minimum of fifteen seconds to wash hands thoroughly to remove all infectious agents, which is about the time you would take to sing 'Happy Birthday to you' twice [2].

Scotland's National Hand Hygiene Campaign is being delivered by Health Protection Scotland, on behalf of the Scottish Government Health Directorate [2]. Its core aim is to improve hand hygiene and to reduce avoidable illness. The high profile campaign is aimed at the general public and health practitioners both in their daily lives and when in hospital as visitors, patients or at work. All hospitals now have alcohol-based hand rubs at the entrance to each ward, and most people are aware of the need to use them. However, these hand rubs are ineffective against *C. difficile* which can only be effectively removed by proper washing with soap and water (2).

This practical addresses the problems associated with poor hand hygiene in a fun way, with a definite 'eugh-yuk' factor which we hope will appeal to teenagers, while getting across a very important message.

More specifically, the practical can be used to investigate:

- i. The transmission of microorganisms through toilet tissue
- ii. The effectiveness of hand washing in removal of microorganisms

Procedure

This experiment would work equally well as an individual investigation or with pupils working in pairs or groups of three.

Materials for each pupil/group

- YGA¹ plates, x2
- dried bakers yeast
- Universal or similar small bottle
- spatula
- disinfectant- Virkon™, or similar
- tap water
- toilet tissue
- cleaning solutions – hand wipes, soap, alcohol rub etc.
- pens for labelling

¹YGA plates contain a nutrient-rich medium that provides everything yeasts need to grow [3].

Method

Add approximately 0.1 g dried yeast (a small spatula full) to the universal, and add around 3 cm³ of fresh tap water. Shake well until the yeast is fully suspended, and then pour onto one of the YGA plates. This is plate 1. Pour off excess liquid into the disinfectant, and discard the universal bottle into disinfectant. This plate is the 'model bottom' (or should it be 'bottom model'?) and the yeast is acting as a model for bacteria which might be found in faecal material. Label the second plate with initials, date and tissue brand and details of investigation (varying one of the factors as discussed below). Divide the plate into four and number the segments 1-4 (Figure 1). This is plate 2. To simulate the normal use of toilet paper, first start by washing your hands well and dry them in your usual manner. Wrap a piece of toilet paper around a forefinger and draw it across Plate 1 (the plate flooded with yeast). Remove the toilet tissue and discard, then roll your forefinger gently but firmly from side to side over section 1 of agar plate 2 (see Figure 2). Wash this finger with either plain water or one of the cleaning agents, dry thoroughly, and then roll it gently but firmly over section 2 on the plate. The whole process can then be repeated in segments 3 and 4 to investigate the effects of changing one factor (see below). Plates should be sealed diametrically with two small pieces of tape and then incubated base uppermost at room temperature for 2-3 days.

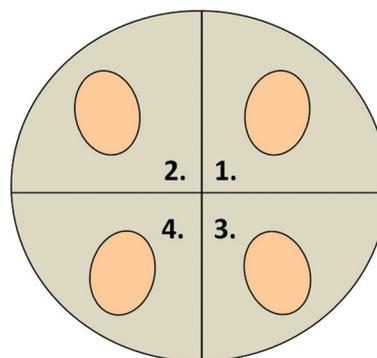


Figure 1

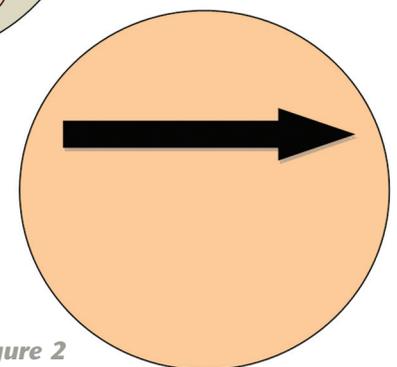


Figure 2

Factors which could be investigated include:

- type of toilet tissue or other household tissues
- number of layers of tissue
- type of cleaning agent, including washing with water alone
- length of time taken to wash fingers

Results

We present results from a variety of investigations. For each plate, section 1 shows the finger roll before washing, 2 shows the finger roll after washing, and 3 and 4 are replicates.

Figure 3 shows that yeast cells can go through one layer of Andrex™, and that they can also remain on the fingers after washing with water.

Figure 4 shows that fewer yeast cells get through two layers of Andrex™, although some can still survive washing with water.

Figures 5 and 6 show that yeast cells travel through two layers of Andrex™, but are removed by washing with the Matron™ or Tesco gel cleanser.

Figures 7 and 8 give results from IZAL™ toilet tissue.

Figure 7 shows that yeast can go through one sheet of IZAL™, and survives washing with water, and Figure 8 shows that yeast can get through two IZAL™ layers. Overall the results show that yeast cells can travel through toilet paper and can also survive washing with water. Our results show that washing with a cleanser removes the yeast.

Plates should not be opened when results are taken, and should be autoclaved before disposal with normal rubbish [3].

Discussion

A major surprise to most people is that the yeast can pass through one or more layers of toilet tissue, and survive some washing. However, once the size of the individual yeast cells and the structure of most toilet tissues are considered, it is perhaps not so surprising. Teachers may want to ask pupils to compare the size of yeast cells to faecal bacteria, and what this could mean in terms of the ease of bacterial transfer. A recent study by researchers from the London School of Hygiene and Tropical Medicine found that overall one in four of people surveyed had some faecal bacteria on their hands [4]. Class results will lead to a lively discussion of current and future behaviour, and will highlight the importance of hand hygiene after a visit to the toilet. Finally, pupils should be encouraged to wash their hands at the end of the practical – perhaps using the guidelines on hand washing from washyourhandsofthem.com, while singing two rounds of 'Happy Birthday to You'.

How does the practical fit into the Curriculum for Excellence?

This practical is suitable for use in many ways, and at different levels. It could easily be incorporated into a cross-curricular study into health and hygiene for first and second year pupils. This could address EO's SCN 3-13b, and SCN 3-20b from Science, and Health and Well Being HWB 3-16a, HWB 2-33a, HWB 3.33a [5]. It could also be used as a full investigation to help the development of scientific inquiry and investigative skills. There is also the potential for development into an Advanced Higher Biology Investigation.

This practical was originally developed for use with undergraduate students at the University of Strathclyde and we are grateful to staff from the University for sharing it with us.

References

1. BMJ.COM (Register free for access to articles)
2. www.washyourhandsofthem.com
3. www.sserc.org – Microbiological Techniques
4. www.ishtm.ac.uk/news/2008/dirtyhandsstudy.html
5. www.science3-18.org/index.php?option=com_content&view=article&id=657&Itemid=16



Figure 3

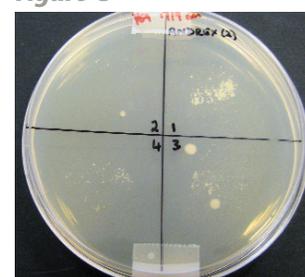


Figure 4



Figure 5



Figure 6

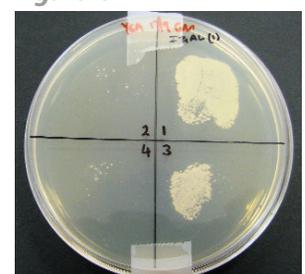


Figure 7



Figure 8