Antibacterial properties of the halogens

Education in Chemistry
Sustainability in chemistry 2021
Goal 6: Ensure availability and sustainable management of water and sanitation for all.
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Chlorine is commonly used in water treatment to kill bacteria. Do all the halogens have antibacterial properties? Which is the most effective?

Antibacterial substances inhibit the growth of bacteria. Investigate the antibacterial properties of the halogens using agar plates that have been lawned with bacteria. Place discs soaked in solutions of the halogens (Cl_2, Br_2 and I_2) onto the agar and look for zones of inhibition.

Apparatus

You will need (between 2):

- One prepared agar plate
- A pair of tweezers
- A marker pen that will write on plastic
- Graph paper
- Access to paper discs soaked in each halogen solution
- Access to a Bunsen burner and heat mat
- A small beaker of ethanol, kept away from the Bunsen burner

Hazards

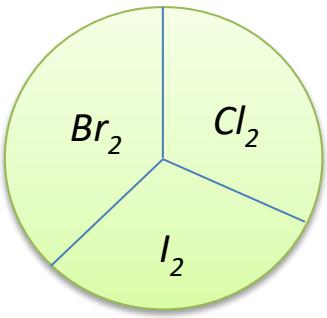
Bacteria are dangerous. Do not touch the agar plates with your fingers, pens etc. Wash your hands after the practical and wipe down the benches with antibacterial disinfectant.

Ethanol is flammable, keep it away from the Bunsen burners. Ideally keep it at one end of the bench and the Bunsen burner at the other end.

Wear eye protection.

Method

1. Collect your agar plate.
2. On a piece of graph paper draw around the bottom of your plate and cut out the circle of paper.
    a. Divide the circle of paper into 3 portions with a pen.
    b. Label each portion Cl_2, Br_2 and I_2 as shown in the diagram.
    c. Secure it to the bottom of your agar plate with sticky tape and/or a couple of dots of glue.



3. Sterilise your tweezers by dipping them in ethanol and then putting them into the Bunsen burner flame (they will be hot after this!).
4. With clean, sterile tweezers, collect a disc of filter paper soaked in $Cl_2(aq)$ and place it in the middle of one portion of the agar plate.
5. Rinse your tweezers with water and then dip them in ethanol and put them back in the flame.
6. Repeat step 4 with paper discs soaked in Br_2 and I_2. Remember to sterilise your tweezers between discs.
7. Put the lid on your plate. Seal your plate by putting pieces of tape at 3, 6, 9 and 12 o'clock. Make sure your names are on it. Give the plate to your teacher for incubation.

Analysis of results

Your teacher will return your agar plate. Bacteria should have grown on the plate except in places where the substances on the discs have acted as antibacterials. Look for areas on your plate around the paper discs that show no bacterial growth, where you can still see through the agar to the graph paper below. This is called a zone of inhibition.

Look at each of the paper circles. Count the number of small squares in the zone of inhibition around each one. Make a table of your results.

Conclusion and questions

1. The aim of this experiment was to find out which aqueous halogen, chlorine, bromine or iodine is best at acting as an antibacterial. Write a conclusion for your experiment, remembering to refer to your results.
2. State some limitations of your conclusion.
3. Consider a water storage tank for a small village. Draw a table and evaluate the advantages and disadvantages of each halogen for purifying the water in the tank using the results from this experiment and your knowledge of the halogens.

Halogen	**Advantage**	**Disadvantage**
Chlorine		
Bromine		
Iodine		

4. Bromine tablets are commonly recommended to people who are travelling in countries where the water is known to contain harmful bacteria. Why do you think bromine is not more commonly used in water treatment?
5. Iodine solution is used to kill bacteria on the skin prior to operations. What property of iodine solution makes it particularly suitable for this use?

Extension questions (16–18)

6. Write an equation to show the equilibrium established when chlorine is dissolved in water.
7. Describe the redox behaviour of chlorine in this equilibrium.