Student Answer Key

The Effects of Colloidal Silver on Microbial Growth: Investigating Snake Oil Science

Materials

Day 1: Practicing Microbial Techniques

- 1 Jell-O Petri dish
- 1 disposable inoculating loop
- Hand held UV lamp

Day 2: Inoculating Petri Dishes

- Petri dishes: LB/E. coli, LB/E.coli/Ag, LB/yeast, LB/yeast/Ag
- 4 disposable inoculating loops
- 10% bleach solution in 250mL beaker
- Permanent marker
- Parafilm® wax

Day 3: Interpretation of Results

- Results Handout

Image Source: http://www.bullioncoinsandbars.com/products-silver-coins.htm

Make a Prediction

If colloidal silver is an effective anti-microbial agent, the Petri dishes containing agar with colloidal silver will not grow *E. coli* or yeast colonies. Alternatively, if microbial growth is detected, this may indicate that the concentration of silver is inadequate to inhibit microbial growth.

Purpose

The purpose of this experiment is to determine if the growth of *Saccharomyces cerevisiae* and Escherichia coli can be inhibited when exposed to low concentrations of colloidal silver.

Safety

Wear goggles and apron when performing this experiment.

Conduct an Experiment

Day 1: Practicing Microbial Techniques

1. Obtain one "Practice Plate" of Jell-O® from your teacher. At your station, you should have 2 disposable inoculating loops, a small sample of Glo Germ™ Oil in a cup, and a handheld UV long-wave lamp.
2. Observe the process of streaking the culture dishes as demonstrated by your teacher. Simulate this process on your own Petri dish using the inoculating loops and the Glo Germ™ available. This approach is intended to familiarize you with the proper handling of instruments and microbial streaking techniques prior to the actual experiment you will perform tomorrow.
3. Use the hand held UV lamp to illuminate the streak lines that you made on the "Practice Plates." How effective is your streaking technique?
4. Dispose of the materials as directed by your teacher, and wash your hands before leaving the class.

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*Development and distribution funded by the **National Science Foundation** through grants DMR-0649199, PHY-0117795, EEC-0601939*

Day 2: Inoculating Petri Dishes

1. Your workstation should have 4 cured Petri dishes labeled LB/*E. coli*, LB/yeast, LB/*E. coli*/Ag, and LB/yeast/Ag, 4 disposable inoculating loops, 10% bleach solution, and a permanent marker.
2. Use the permanent marker to label your group name on the bottom of each Petri dish.
3. Once the bacteria have been prepared by your teacher, use a sterile inoculating loop to streak the Petri dish labeled LB/*E. coli* using the same method that you practiced yesterday. Place the used disposable inoculating loop into a 10% bleach solution for 20 minutes to decontaminate prior to disposal.
4. Repeat step 3 for the Petri dish labeled LB/*E. coli*/Ag.
5. Immediately replace the covers and return the plates to the inverted position. Use Parafilm® wax to wrap the stacked dishes. Store at your workstation, or other place indicated by your teacher, for an incubation period of 24-48 hours.
6. Your teacher will prepare a sample of Baker's yeast. When the yeast have been activated, use a sterile inoculating loop to streak the remaining Petri dishes labeled LB/yeast and LB/yeast/Ag. Use a different inoculating loop for each dish and adhere to all safety practices for the handling of microorganisms, and the disposal of contaminated material. You can store these plates in the same way as the *E. coli* starter dishes and at the same temperature, and for the same duration.

Day 3: Interpretation of Results

1. Retrieve your Petri dishes labeled LB/*E. coli*, LB/*E. coli*/ Ag, LB/yeast, and LB/yeast/Ag. You will have an opportunity to interpret the results of your experiment.
2. Record your observations on the student handout distributed.
3. Discuss with your partner(s) the results of your experiment and work on the accompanying discussion questions. What do your results suggest about the relationship between colloidal silver and microbes such as *E. coli* and yeast? What do your results indicate about colloidal silver as an antimicrobial agent? Are your results conclusive?

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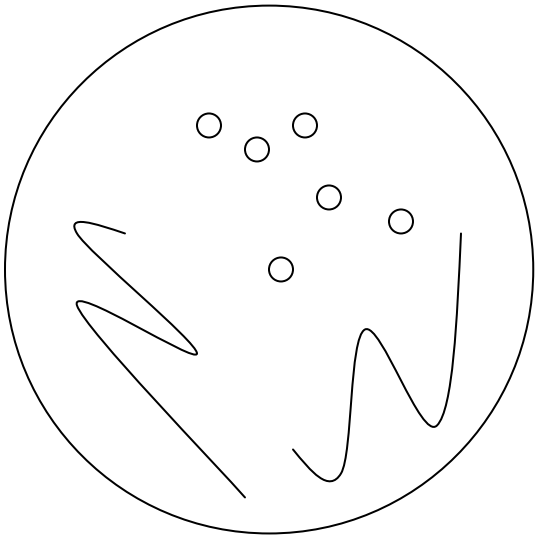
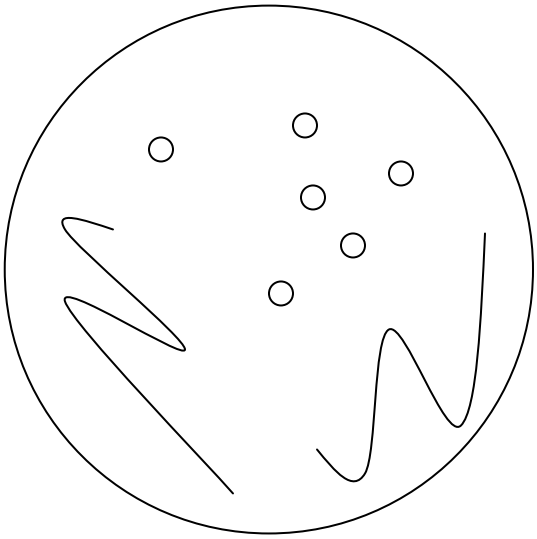
Record your observations

Name_____Period_____Date_____

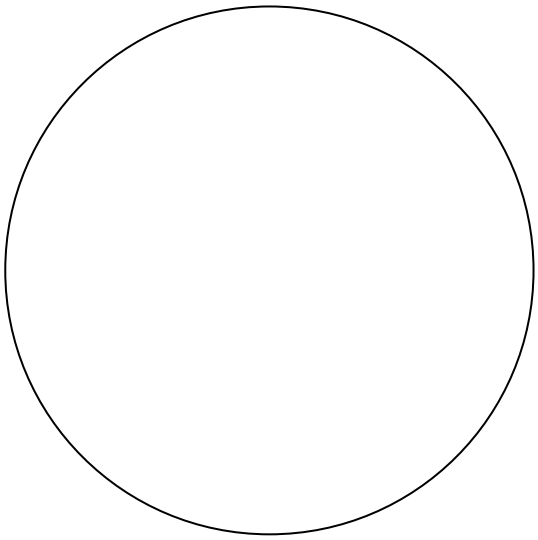
Results of the Effects of Silver on Microbial Growth



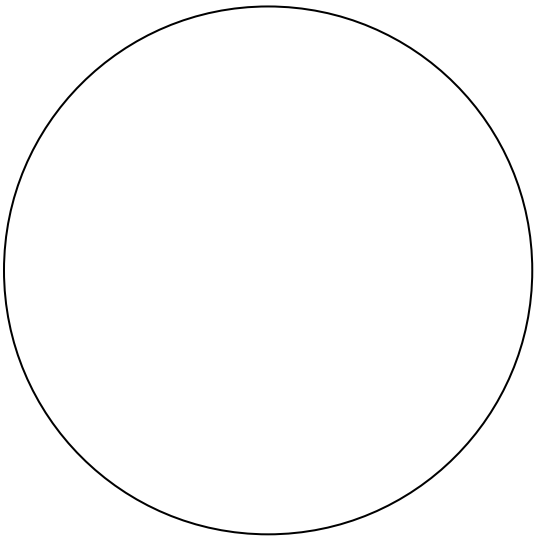
Petri Dish Name: LB/*E. coli*
Control or Experiment? Control
Record written interpretation of results:
Growth should continue to grow with many, small to medium sized off-white colonies



Petri Dish Name: LB/yeast
Control or Experiment? Control
Record written interpretation of results:
Growth of large off-white colonies similar to *E. coli* plate



Petri Dish Name: LB/*E. coli*/Ag
Control or Experiment? Experiment
Record written interpretation of results:
Results have been inconclusive. However, further experimentation should show normal growth, similar to the control, at this level of Ag concentration.



Petri Dish Name: LB/yeast/Ag
Control or Experiment? Experiment
Record written interpretation of results:
Results have been inconclusive. However, further experimentation should show normal growth, similar to the control, at this level of Ag concentration.

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NNIN Document: NNIN-1289
Rev: 06/2012

Interpreting Results

1. Did you observe what you predicted?

   _____

   If not, how did your observation differ from your prediction?

   _____

   _____

2. Why was it important to have a control group?

   It is important in any experiment to have a control because the control provides your experimental data with a means of comparison.

3. Do your observations leave you with any more questions? Do they enable you to make more predictions? If so, what are they?

   If the experimental Petri dishes exhibit microbial growth, students may conclude that 1) the colloidal silver claims are inaccurate, or 2) the colloidal silver generated is not present in the agar in a high enough concentration to yield an inhibitory effect. Conversely, if growth is inhibited, students may conclude that 1) purported antimicrobial properties are accurate, or 2) colloidal silver prevents the growth of these two species of microorganisms. Further experimentation may include testing other types of microorganisms, increasing or decreasing the concentration and particle size of colloidal silver, and even purchasing the online colloidal silver products to repeat the aforementioned experiment.

Applying the Results

4. Construct an advertisement similar the one below that promotes the benefits of colloidal silver.

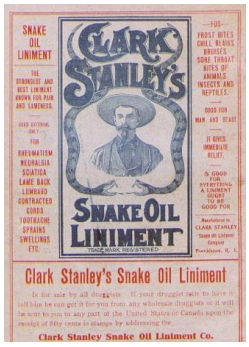

Image Source:
http://www.nlm.nih.gov/exhibition/ ephemera/medshow.html

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5. On a recent family visit to see your great-aunt Lucy, you notice that the cough she complained about on your last visit has not responded to the cough syrup and regimen of lozenges that she keeps in her housecoat pocket. She tells you that her friends at Bingo were telling her about a novel therapy called "liquid silver" which is supposed to treat most major ailments that are bacterial or viral in nature. She is considering giving the treatment a try. Based on the results of this investigation and what you know about colloidal silver, what would you tell your great-aunt who is considering using a similar product to help subdue her persistent cough? Be persuasive.

6. Design a follow-up experiment based on your results. If your Petri dishes failed to grow, describe a controlled experiment to test why. If your Petri dishes successfully grew colonies of fungi and bacteria, describe a follow-up controlled experiment.

7. In 3 to 5 sentences, respond to the following statement: When a scientist has completed an experiment that supports his/her hypothesis, then his/her inquiry into this concept is complete.

Draw Conclusions

8. Based on your results, can you say for certain that colloidal silver exhibits antimicrobial properties? Explain your answer.

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