Hamburger SCIENCE

Students learn the importance of food safety practices

Ann Trent

While babysitting or preparing home meals, young people (and adults too) sometimes overlook cleanliness procedures. One of the first employment opportunities for teenagers is often in a fast-food restaurant where the safe handling and proper cooking of foods is essential. To teach students about food safety practices, the U.S. Food and Drug Administration (FDA) and the National Science Teachers Association (NSTA) formed a partnership to develop a free curriculum kit titled *Science and Our Food Supply* (FDA and NSTA 2001).

Of the many lab activities in the program, the one most anticipated by my students is "the hamburger lab" (FDA and NSTA 2001, 60). Students use a controlled experiment to fry meat, swab for bacteria, and incubate agar plates to determine bacteria-safe cooking temperatures.

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FIGURE 1

Hamburger lab materials and procedure.

Each lab group needs the following materials:

- Aprons and goggles
- Hot plate
- Turner (spatula)
- Ground beef (227 g)
- Sterile cotton swabs
- Five nutrient agar plates (labeled: control, raw, 50°C, 60°C, 70°C)
- Parafilm
- Ruler
- Rubber or latex gloves
- Skillet
- Meat thermometer
- Paper plates
- Alcohol wipes
- Marker
- Balance or scale and a 50 g weight
- Hot pads/oven mitts

Procedure:

1. Prepare a control agar plate and set it aside.
2. Remove a small section of raw meat and swab inside the hamburger to get the juices. Inoculate the "raw plate."
3. Divide the remaining hamburger in thirds. Weigh each third to ensure equal weight (50 g). Make three patties, each 1.3 cm thick.
4. Cook one patty to 50°C. Don't push the patty down with the spatula, it will squeeze the juices out!
5. Lift the patty out of the pan with a spatula and place it on a clean paper plate. Take the temperature of the patty.
   - Take the temperature by inserting the thermometer through the side into the center of the burger.
   - If the temperature hasn't reached 50°C, return the patty to the skillet and continue to cook.
   - If the temperature is higher than 50°C return the patty to the skillet and continue to cook to 60°C. Cook the next patty to 50°C.
   - Clean the thermometer with an alcohol wipe each time it is used to prevent cross-contamination.
6. When the desired temperature is reached, place the burger on a paper plate. Break the patty in half and swab the inside with a sterile cotton swab to get the juices from the burger. Inoculate the agar plate labeled 50°C.
7. Repeat this procedure cooking patties to 60°C and 70°C.
8. Tape the agar plates with parafilm to seal.
9. Place the inoculated plates and the control plate in an incubator at 32°C for 48 hours, or let them sit at room temperature for three to four days.

Safety first

Before we begin the activity, I insist that my students wear lab aprons and goggles and I caution students on how to avoid possible burns from the hot plate and grease splatters. By the time we conduct this lab, students have previously practiced sterile procedures for inoculation, sealing, and incubation, so these are not new techniques. As with all labs in the *Science and Our Food Supply* unit, students must wash their hands thoroughly before and after handling any raw meat, and must wear disposable gloves. For safety, all agar plates remain sealed after incubation.

I require students to clean up their workstations as carefully and thoroughly as if they were working at a high quality restaurant. I provide dishwashing soap and drying towels, and expect the area to be clean and ready for the next class by the end of the period. I also remind students throughout the activity that foods prepared in the lab must not be eaten. No exceptions!

Conducting the lab

I usually assign lab groups of four to five students and set out all supplies at the workstations (Figure 1). I put the ground beef in plastic bags the day before lab for each group; the bags can then be used to weigh equal-sized patties. I also provide a typed step-by-step procedure for students to follow (Figure 1).

Teachers should be aware that students tend to spend far too much time shaping and measuring the hamburger patties. Students also tend to slow the cooking time by checking the temperature too soon and too frequently. To counter this issue, students should be told that a hamburger cooked to 50°C is rare with a bright pink middle, while the edges are done. Because students may slow down the process in the first part of the lab, by the end of the period students try to take shortcuts. To save time, students may try to insert the thermometer into the meat while it is still in the skillet, which is completely unacceptable! Another shortcut students sometimes take is to cook several

patties at the same time—this can be done only if a close watch is kept on the meat.

A common error is cross-contamination. Students overlook the necessity of using a clean paper plate for the cooked meat or forget to clean the thermometer between uses with an alcohol swab. These mistakes replicate common unsafe cooking practices and initiate discussions on how easily bacteria are spread from one place to another.

At the conclusion of the lab, students observe their incubated dishes and write their reports to include the number, shape, and size of the bacteria colonies. I have students observe the results from other teams and compare and contrast growth. If the experiment has been conducted properly, the 70°C plate should have little or no bacterial growth, while the others should reveal thriving bacterial colonies. As already noted, agar plates should remain sealed after incubation.

Safety precaution is essential when disposing of bacteria after observations have been completed. Students must submerge their disposable plates in a disinfecting bleach solution. This solution is easily prepared with 20 mL of liquid household chlorine bleach added to 1 L of tap water. I transfer all disinfected plates to a tightly closed plastic bag that is discarded in the trash.

There is always a saddened rare steak lover in the class who is troubled by the discovery of bacteria in undercooked hamburger. For this person I explain that bacteria are on the outside surface of meat. Therefore, a steak that is cooked on both sides is perfectly safe to eat. Ground beef, on the other hand, is exactly that—ground up. The outside is all mixed with the inside, including any bacteria, and therefore needs to be cooked thoroughly (see "Ask the Experts," p. 64).

Student inquiry

Many variations of this activity exist and provide opportunities for student-based inquiry. Different types of meat could be tested, such as turkey or pork, or even a veggie burger. Would the amount of time sitting in the sink to thaw affect bacterial growth? Would the room temperature affect the meat? Is it ok to get that meat out of the refrigerator in the morning and not cook it until suppertime? Is it safe to serve meat on the same plate that was used to bring it to the grill? Students should be encouraged to design experiments to test their ideas, which may originate from procedures in their own homes.

Extension ideas to the activity are also educational. I assign students to research a foodborne pathogen and report their findings to the class. These reports have been in the form of posters, PowerPoint presentations, puppet shows, and game shows. Students have also created informative brochures on food safety to distribute to the public. Hearing students proudly declare the scientific name of their foodborne pathogen still makes me smile. Among other facts, the pathogen's food sources, symptoms of the illness, and the steps for prevention are included in a presentation to their classmates.

Perhaps a trip could be arranged to a local fast-food restaurant to see how they insure that hamburgers are cooked to a safe internal temperature. Another extension is to study novels that deal with food preparation and sanitary conditions, such as *Everything on a Waffle* by Polly Horvath (2001), or *Hope Was Here* by Joan Bauer (2002). (I was recently awarded a 2004 Toyota TAPESTRY large grant that will give my science students, along with literature students, the chance to study these novels.)

A growing concern

A variety of reasons exist for why food safety is more of an issue now than ever before. Food in local stores throughout the United States comes from all over the world, which may introduce new microorganisms. In addition, today there are five times more foodborne pathogens identified than were even known in 1950, and many of them are antibiotic resistant.

The Centers for Disease Control and Prevention (CDC) states that nearly 25 percent of the U.S. population is at risk for serious symptoms from foodborne illness. Among those most at risk are the elderly, the young, pregnant women, and those with underlying illnesses such as diabetes, cancer, and kidney disease. According to the CDC, 76 million gastrointestinal illnesses, 325,000 hospitalizations, and 5,000 deaths occurred in 1999 due to bacterial foodborne pathogens (CDC 2002). Learning about food safety will help students make better decisions concerning food handling and promote safety practices that can truly impact their personal health. ■

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U.S. Food and Drug Administration (FDA) and National Science Teachers Association (NSTA). 2001. *Science and Our Food Supply*. New York: JMH Educational Marketing, Inc. *www.foodsafety.gov/~fsg/teach.html* or *www.nsta.org/288*.

On the Web

American Meat Institute (AMI): *www.meatami.org*

Color of Cooked Ground Beef as It Relates to Doneness: *www.fsis.usda.gov/oa/pubs/colortech.htm*

Gateway to Government Food Safety: *www.foodsafety.gov*

Food Safety for Teen Cooks: *www.kidshealth.org*

Home Food Safety: *www.eatright.org*

National Cattlemen's Beef Association: *www.beef.org*

The Partnership for Food Safety Education: *www.fightbac.org*