Make Your Own Yogurt

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Topic

Beneficial bacteria

Time

1½ hours for preparation, 12 hours for incubation

Safety

Please click on the safety icon to view the safety precautions. Tasting the final product (the yogurt) is not recommended.

Materials

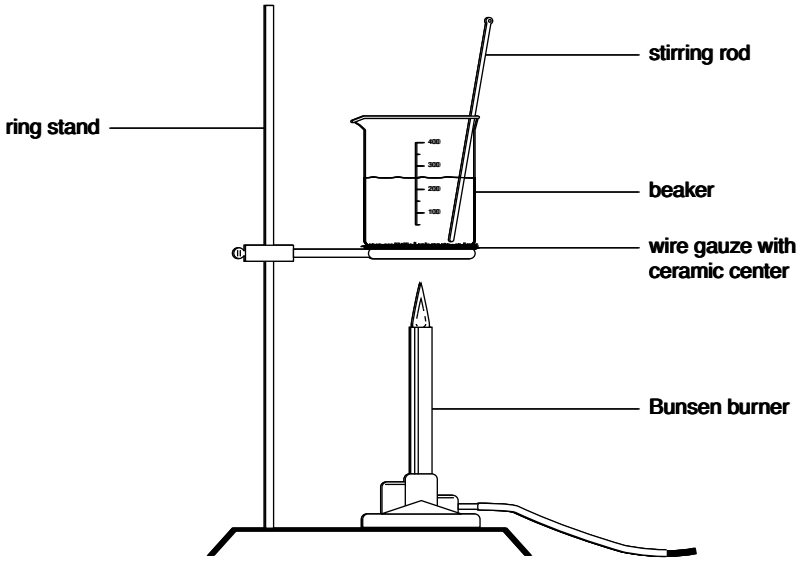
liquid dishwashing detergent
soft, clean towels
yogurt maker or wide-mouthed thermos
750 mL (about a quart) of 2% or 4% fat homogenized pasteurized milk
400-mL heat-resistant graduated beaker
250-mL beaker
metal pan
plastic pan
container of plain yogurt containing active yogurt cultures
100-mL beaker or small glass container
teaspoon
plastic wrap
hot plate, stove, or Bunsen burner and ring stand with wire gauze with ceramic center
Celsius thermometer
glass stirring rod
refrigerator or a 250-mL beaker in a cooler with ice

Procedure

Before you begin, make three copies of the data table.

Trial A: Control

1. Make sure all pieces of equipment to be used are absolutely clean; wash them thoroughly with warm water and detergent. Rinse thoroughly with warm water and dry with a clean towel.
2. Plug in the yogurt maker or warm the wide-mouthed thermos with boiling water.
3. Measure out 250 mL milk in a 400-mL graduated beaker.
4. Heat the milk to 82°C. If you are using a stove or hot plate, place the beaker of milk in a pan of water to heat. If you are using a Bunsen burner, set up the milk on the ring stand as shown in the illustration.



5. Cool the milk to 43°C by putting the beaker in a pan of cool water.
6. Put four level teaspoons of yogurt into a 100-mL beaker or a small glass container, and slowly add about 25 mL of the 43°C milk until you have a thin mixture.
7. Add the mixture from step 6 to the rest of the warm milk and stir thoroughly. (You are adding the bacterial culture to the milk.)
8. Pour the milk into the yogurt maker jars or a warm thermos bottle for incubation. Cover the jars, or screw on the stopper of the thermos to incubate for at least 12 hr.
9. Uncover and observe the jars or thermos of milk, and write your observations on the data table below.

DATA TABLE			
Mixture characteristics	Trial A	Trial B	Trial C
Consistency of mixture			
Smell of mixture			

TRIAL B: INCUBATION AT A LOW TEMPERATURE

Repeat the experiment, following the same steps as in A, except for steps 2, 8, and 9. Use steps 2, 8, and 9 below instead:

2. Make space in a refrigerator, or put ice in a cooler.
8. Pour the milk into the yogurt maker jars or into the 250-mL beaker. Cover with plastic wrap. Then either refrigerate until the following day or leave in the ice-filled cooler.
9. Uncover and observe the jars or beaker of milk and write your observations on the data table.

What's Going On

The mixture incubated at 43°C, in Trial A, forms yogurt. In Trial B, the low temperature greatly slows bacterial growth and reproduction; thus no yogurt is formed. In *Trial C*, the yogurt bacteria added to the 82°C milk are killed by the high temperature, so, again, no yogurt forms during incubation. The hypothesis is correct. The milk was first heated to 82°C to kill any harmful bacteria present in it before the yogurt bacteria were added. The milk was cooled to 43°C because the higher temperature kills the yogurt bacteria, and thus no yogurt would be made. The milk-yogurt mixture kept cool will form yogurt if you subsequently incubated it at 43°C. The yogurt bacteria in it are still alive, and in the right temperature conditions they will grow and reproduce. Most of the bacteria eaten in the yogurt will be killed off during digestion, so under ordinary circumstances they will have little effect on the eater.

Although there have been no conclusive studies conducted with humans, some nutritionists believe that eating yogurt may aid digestion by helping to replenish the beneficial bacteria naturally present in a person's digestive system in situations in which these have been depleted, such as after a course of antibiotics. One form of yogurt-making bacteria is routinely fed to young cattle for this purpose. Since Swiss-style yogurt has no active yogurt culture (live bacteria), it will not generate additional bacteria; thus no yogurt will form at any temperature.

Connections

Yogurt, which people have been making and eating for hundreds of years, is produced by bacteria. In fact, when you eat yogurt with active cultures in it, you are eating some live bacteria. All organisms, from people to bacteria, have a range of temperature in which they thrive-called the *optimal temperature*. People who make yogurt need to conduct trials like the ones in this experiment to determine the optimal temperature for the bacteria they wish to grow. Yogurt is actually milk that has been "soured" by bacteria. *Lacto-bacillus casei* converts the lactose in milk to lactic acid. Hypothesis: Yogurt grows best at a warm temperature.

Safety Precautions

READ AND COPY BEFORE STARTING ANY EXPERIMENT

Experimental science can be dangerous. Events can happen very quickly while you are performing an experiment. Things can spill, break, even catch fire. Basic safety procedures help prevent serious accidents. Be sure to follow additional safety precautions and adult supervision requirements for each experiment. If you are working in a lab or in the field, do not work alone.

This book assumes that you will read the safety precautions that follow, as well as those at the start of each experiment you perform, and that you will *remember* them. These precautions will not always be repeated in the instructions for the procedures. It is up to you to use good judgment and pay attention when performing potentially dangerous procedures. Just because the book does not always say "be careful with hot liquids" or "don't cut yourself with the knife" does not mean that you should be careless when simmering water or stripping an electrical wire. It *does* mean that when you see a special note to be careful, it is extremely important that you pay attention to it. If you ever have a question about whether a procedure or material is dangerous, stop to find out for sure that it is safe before continuing the experiment. To avoid accidents, always pay close attention to your work, take your time, and practice the general safety procedures listed below.

PREPARE

- Clear all surfaces before beginning work.
- Read through the whole experiment before you start.
- Identify hazardous procedures and anticipate dangers.

PROTECT YOURSELF

- Follow all directions step by step; do only one procedure at a time.
- Locate exits, fire blanket and extinguisher, master gas and electricity shut-offs, eyewash, and first-aid kit.
- Make sure that there is adequate ventilation.
- Do not horseplay.
- Wear an apron and goggles.
- Do not wear contact lenses, open shoes, and loose clothing; do not wear your hair loose.
- Keep floor and work space neat, clean, and dry.
- Clean up spills immediately.
- Never eat, drink, or smoke in the laboratory or near the work space.
- Do not taste any substances tested unless expressly permitted to do so by a science teacher in charge.

USE EQUIPMENT WITH CARE

- Set up apparatus far from the edge of the desk.
- Use knives and other sharp or pointed instruments with caution; always cut away from yourself and others.
- Pull plugs, not cords, when inserting and removing electrical plugs.
- Don't use your mouth to pipette; use a suction bulb.
- Clean glassware before and after use.
- Check glassware for scratches, cracks, and sharp edges.
- Clean up broken glassware immediately.

- Do not use reflected sunlight to illuminate your microscope.
- Do not touch metal conductors.
- Use only low-voltage and low-current materials.
- Be careful when using stepstools, chairs, and ladders.

USING CHEMICALS

- Never taste or inhale chemicals.
- Label all bottles and apparatus containing chemicals.
- Read all labels carefully.
- Avoid chemical contact with skin and eyes (wear goggles, apron, and gloves).
- Do not touch chemical solutions.
- Wash hands before and after using solutions.
- Wipe up spills thoroughly.

HEATING INSTRUCTIONS

- Use goggles, apron, and gloves when boiling liquids.
- Keep your face away from test tubes and beakers.
- Never leave heating apparatus unattended.
- Use safety tongs and heat-resistant mittens.
- Turn off hot plates, bunsen burners, and gas when you are done.
- Keep flammable substances away from heat.
- Have a fire extinguisher on hand.

WORKING WITH MICROORGANISMS

- Assume that all microorganisms are infectious; handle them with care.
- Sterilize all equipment being used to handle microorganisms.

GOING ON FIELD TRIPS

- Do not go on a field trip by yourself.
- Tell a responsible adult where you are going, and maintain that route.
- Know the area and its potential hazards, such as poisonous plants, deep water, and rapids.
- Dress for terrain and weather conditions (prepare for exposure to sun as well as to cold).
- Bring along a first-aid kit.
- Do not drink water or eat plants found in the wild.
- Use the buddy system; do not experiment outdoors alone.

FINISHING UP

- Thoroughly clean your work area and glassware.
- Be careful not to return chemicals or contaminated reagents to the wrong containers.
- Don't dispose of materials in the sink unless instructed to do so.
- Wash your hands thoroughly.
- Clean up all residue, and containerize it for proper disposal.
- Dispose of all chemicals according to local, state, and federal laws.

BE SAFETY-CONSCIOUS AT ALL TIMES