LAB 9

WHY ARE PRESERVATIVES DESIRABLE IN OUR FOOD?

PREVIEW

Introduction

Late summer is harvest time at the Skinner's truck farm. By late July, cherry, peach, and pear trees in the orchards are full of nearly ripe fruits. What is not loaded onto trucks headed for roadside markets is canned right in the Skinner home, then sold to shops.

The action takes place in the Skinner kitchen. Ruth Skinner and her daughter are busy washing and paring the fruit that has just been picked—freestone peaches, Bartlett pears, and Bing cherries.

Ruth, who has spent the morning washing canning jars and pressure cookers, cuts each piece of washed fruit into a bowl of water to which she has added one or more preservatives (salt, vinegar, citric or ascorbic acid). She has also prepared different weights of syrups in which she will can the fruit.

Ruth's daughter, Doris, explains the reason for the preservatives. "Anytime the soft parts of fresh fruits and vegetables are exposed directly to air, darkening naturally begins. Some fruits, especially peaches, brown badly after they are cut. And some fruits continue to brown even after canning. For instance, apples—to keep them from browning, add 2 tablespoons of salt and 2 tablespoons of vinegar to a 4-quart bowl of water. If apples are soaked for several minutes in this solution, they will come out of the pressure cooker with a bright, natural color. That's important to people who buy canned fruit to make pies, preserves, and salads."

Purpose

In this lab, you will retard the process of oxidation in foods.

Lab 9
Why Are Food Additives Desirable in Our Food?

OVERVIEW

Description: Students prepare a preservative solution of their choice to keep a fruit or vegetable from browning. They slice the food directly into the preservative and periodically compare it to untreated samples exposed to air or wrapped in plastic.

Purpose: In this lab, students will retard the process of oxidation in foods.

Lab Skills: Use a balance to weigh solids.
Make up solutions.

Minimum Lab Requirement: This lab should be conducted in a space with tables or counterspace allowing food to be cut up and observed for up to 24 hours.

Time Required: This lab can be conducted in a 50-minute class period followed by short observation periods during the next 24 hours.

LABORATORY PREPARATION

Be prepared to review or introduce any of the following topics:

- Enzyme action and food preservation
- Oxidation
- Preparing solutions

After procuring all equipment, you will need to do the following before students can start the procedure:

1. Carefully refrigerate or store as appropriate all produce that will be preserved. Take care not to bruise it.
2. Set out on the lab counter:
    a. preservatives as they are listed in the "Materials and Equipment Required" list, and include utensils for measuring required amounts. It is not necessary to weigh amounts; students can refer to concentrations of preservatives simply as 10 grams per 100 ml, and so on.
    b. one or several whole pieces of each fruit and vegetable.
    c. cutting boards, knives, aluminum foil (or plastic plates), plastic wrap, and plastic spoons.
    d. 250-ml beakers and 100-ml graduated cylinders.
    e. wax pencils and labels.

MATERIALS AND EQUIPMENT REQUIRED

This section itemizes the materials required for this lab. Note that some of the materials cited may be used in other laboratory activities in the *Applications in Biology/Chemistry* series.

Item	Quantity
apples, bananas, pears, avocados (and/or other easily browned produce)	1 supply per class
sugar	1 lb per class
salt	1 box per class
ascorbic acid, powdered, or vitamin C tablet	1 supply per class
lemon juice, reconstituted	1 pint per class
citric acid	1 box per class
refrigerator	1 per class
beakers, 250 ml	1 per lab station
beakers, 600 ml (optional)	1 per preservative
hot plate (optional)	1 per class
distilled water	NA
knife and cutting board	1 per lab station
spoon, plastic	1 per lab station
spoons, measuring	1-2 sets per class
cylinder, graduated, 100 ml	2-3 per class
pencils, wax	1 per lab station
plastic wrap	1-2 rolls per class
plastic plates or aluminum foil	1-2 pkg per class
stick-on labels or masking tape	1 supply per class
paper towels	1-2 rolls per class
apron, lab	1 per student

Lab Objectives

When you've finished this lab, you will be able to—

- Vary conditions that inhibit oxidation.
- Select appropriate methods of food preservation.

Lab Skills

You will use these skills to complete this lab—

- Use a balance to weigh solids.
- Make up solutions.

Materials and Equipment Needed

fresh fruit or vegetable (apple, banana, pear, avocado)
preservatives
sugar
salt
Fruit Fresh™
ascorbic acid
citric acid
lemon juice
250-ml beakers
600-ml beakers (optional)
distilled water
knife and cutting board
refrigerator
spoon
plastic wrap
plastic plate or aluminum foil
stick-on labels or masking tape
paper towels

Pre-Lab Discussion

Most food additives are substances intentionally added to food for a specific purpose. They include preservatives and antioxidants (to prevent spoilage), flavors and stabilizers (to enhance taste and appearance), and supplementary vitamins and minerals.

Both natural and synthetic preservatives enable us to improve the quality of food and the shelf life. Substances as common as salt, sugar, lemon juice, and vitamin C are added to foods to help preserve them. These substances slow a process that is occurring all the time, the process of oxidation.

As its name implies, oxidation is related to oxygen. Oxidation in fruits and vegetables is caused when oxygen enters exposed food and reacts with substances naturally present in food. In addition, the cutting of a fruit or vegetable releases enzymes in the food necessary to the oxidation process.

PROCEDURE

SAFETY PRECAUTIONS

Review the safety precautions with your students. A **blackline master** explaining the lab safety icons used in this lab is provided on page M-51. Below are safety considerations related to specific steps of the laboratory procedure.

Step 4: Show students how to properly slice various fruits and vegetables.

CRITICAL STEPS

Step 2: See "Materials and Equipment Required" for suggested preservative solutions.

Steps 4-5: The same piece of food can be used in both steps. Do not cut food so thin that you can see light through the slices. Do not let students peel or eat fruits or vegetables.

This may cause changes in appearance, such as browning, as well as alter taste and nutritional value.

By inhibiting oxidation, preservatives help maintain the natural color, texture, and tastes of processed foods that have been exposed to air.

Safety Precautions

- Be careful when cutting with the knife.
- Do not eat the food being used for the lab.

LAB PROCEDURE

Method

Work in groups of two. Put on your lab apron.

1. From the lab counter, choose a fruit or vegetable and the preservative you think will best prevent browning without affecting taste. Write the name of the food in the data table.
2. Make up a solution of the preservative according to your teacher's instructions or your own.
3. Pour 100 ml of your preservative into a 250-ml beaker. Label the beaker with the name of the preservative.

4. Cut the piece of food into equal-size slices.
   - Using a knife and cutting board, cut out any bruised areas of the food.
   - Place slices of the food you chose on a sheet of foil or on a plastic plate. Label these "control."
   - Seal equal-size pieces of the food tightly with plastic wrap to keep out air.
   - Place them on the foil or plate and label them "untreated/wrapped."
5. Apply preservative to food by:
   - Slicing equal-size pieces of food directly into the beaker of preservative. Do not allow preservative to splash from the beaker.

Step 6: The major change will be browning, which should be most noticeable in the Control and the Untreated/Wrapped samples.

SAMPLE DATA AND CALCULATIONS

Data Table: Condition of Preserved and Unpreserved Produce

Food: **Avocado**	Appearance of Food After 10 min	Would You Eat?	Appearance of Food After 1 hr	Would You Eat?	Appearance of Food After 16 hr	Would You Eat?
Control	fresh	yes	slightly browned	no	badly browned	no
Untreated/ wrapped	fresh	yes	fresh	yes	slightly browned	no
Preservative: vitamin C 400 mg/100 ml	fresh	yes	fresh	yes	slightly browned	no
Other preservatives						
Salt (3 tsp/100 ml)	fresh	yes	fresh	yes	badly browned	no
Lemon juice (full strength)	fresh	yes	fresh	yes	slightly browned	maybe
Citric acid (1/4 tsp/100 ml)	fresh	yes	fresh	yes	moderately browned	no

CLEANUP INSTRUCTIONS

Be sure any solutions to be stored for later use are properly labeled.

- After several minutes, gently remove pieces of food from beaker using a spoon. Place them onto a clean paper towel to absorb some of the excess liquid.
- Place pieces of food on the foil or plate and label with the name of the preservative.

6. Observe any changes in appearance of the food after 10 minutes. Record these in the data table. Also indicate whether the food still looks good enough to eat.
7. Cover food with plastic wrap and refrigerate. Return in several hours (and on the following day) to observe the appearance of the food. Record your results in the data table.
8. Each group should report its findings to the class.

Data Table: Condition of Preserved and Unpreserved Produce

Food:	**Appearance of food after 10 min**	**Would you eat?**	**Appearance of food after ____ hr**	**Would you eat?**	**Appearance of food after ____ hr**	**Would you eat?**
Control						
Untreated/ wrapped						
Preservative:						
Other preservatives						
1.						
2.						
3.						

Cleanup Instructions

- Discard used fruit and vegetables into the trash.
- Discard used preservatives by pouring them down the drain.
- Wash, rinse, dry, and store beakers.
- Store remaining preservative solutions in the refrigerator.

WRAP-UP

CONCLUSIONS

1. Untreated samples of pears, apples, avocados, and bananas should show extensive browning by the end of the lab period. Foods treated with preservatives should stay fresh for most of the lab period but may be spoiled by the next day, depending on the type and concentration of preservative used.
2. Group results can be presented to the class in the form of a graph and added to a class graph as each group finishes the presentation.

   Since analysis of results is purely qualitative and subjective, expect some disagreement in decisions regarding preservatives. The chief criteria are that the preservative slows browning and does not conflict with the taste of food, as would, say, a salt solution to preserve pears.

EXTENSIONS

4. Refrigeration will slow browning even if foods are exposed to air inside the refrigerator. Since browning is an enzyme-catalyzed process, it is influenced strongly by changes in temperature. Low temperatures inhibit enzyme action.
5. By inactivating food enzymes, blanching should encourage browning in all food samples.

WRAP-UP

Conclusions

1. Compare the pieces of food not treated with preservatives (wrapped versus unwrapped). Explain any differences in appearance.
2. Present to the class the results of your experiment.
   - Give the formula for the preservative you used.
   - Report the appearance of the food after each observation.
   - Ask the class to decide whether your food still looks good enough to eat.
3. Based on the class results, which preservative worked best for a particular food?

Extensions

4. Repeat this lab with fresh fruits and vegetables treated with preservatives but kept refrigerated. Compare the results with the results obtained at room temperature.
5. Blanching is a preservation technique in which foods are exposed to boiling water or steam for a short period of time to halt enzyme activity. It is typically used prior to freezing. Test the effect of blanching on food preservation using the following procedure.
   - Fill a 500-ml beaker with 250 ml of water.
   - Bring to a boil on a hot plate.
   - Cut up your food items.
   - Carefully put food into the boiling water. Avoid splashing the boiling water on yourself or others.
   - Boil for 1 minute.
   - Remove the pieces. Plunge in cold water and immediately treat with preservatives.
   - Observe at room temperature every 10 minutes and record your results.
   - Describe the effect of blanching on your results.

Safety Icons

Exercise extreme care around open flames. Keep flammable materials away from open flames and sparks.

Do not inhale, ingest, or expose your skin to toxic substances.

Avoid skin contact w/potentially harmful chemicals such as acids, bases, dyes. Wear gloves and lab apron.

Put on your goggles to protect your eyes in the event of a chemical splash or encounter with sharp objects, harmful vapors, and airborne particles.

Exercise care when working near hot surfaces such as hot plates and heated glassware. Handle such materials with hot pads.

Avoid breathing vapors of chemicals referred to by this symbol. Work under a hood when possible.

This is a general warning symbol for potentially harmful situations not indicated by another safety icon. If you are uncertain about what this symbol refers to in your lab exercise, ask your teacher immediately.