

# Food Explorations Lab I: Enzymatic Reactions

## STUDENT LAB INVESTIGATIONS

Name: \_\_\_\_\_

### Lab Overview

There are two parts to this investigation. In Part A, you will observe and compare three types of fruit for enzymatic browning. In Part B, you will choose two substances to test for their ability to inhibit or slow enzymatic browning.

### Lab Objectives

*In this lab, you will learn how to...*

1. Determine which types of fruit are susceptible to enzymatic browning.
2. Explore potential methods for inhibiting enzymatic browning.

**Lab Safety:** Before beginning ANY investigation you should put on your safety goggles and apron. It is important to avoid getting chemicals on your body. Always wash your hands following completion of an investigation. When handling food, you should also wash your hands prior to beginning an investigation.

## PART A: Observation of Enzymatic Browning in Fruit

### MATERIALS

1 cutting board  
3 plastic or blunt knives  
3 paper plates (any size)  
Kitchen timer or stopwatch  
Fruit ( $\frac{1}{4}$  of an apple,  $\frac{1}{4}$  of an orange,  $\frac{1}{4}$  of a banana)  
Paper towel or napkin  
Safety goggles  
Aprons (optional)

### PROCEDURE

1. Prepare your fruit types. Cut the apple and orange into thirds using a different knife for each fruit. Cut the banana into small slices.
2. Separate each fruit type onto separate plates (you should have a total of three plates). Make sure the flesh of the fruit is facing upward.
3. Once your fruit samples have been prepared, you are ready to begin. Describe your *visual* observations of each fruit in Table A under "0 minutes". *DO NOT smell or taste any of the samples.*
4. Allow each fruit to sit for 10 total minutes (set your timer). While you wait, predict what you think will happen to each fruit after 10 minutes have passed and provide evidence to support your prediction. Will you observe changes in texture? Changes in color?

	After 10 minutes, I predict...	because...
the apple will...		
the orange will...		
the banana will...		

5. Describe your observations after 10 minutes in Table A. While you wait, proceed to Part B of the lab investigation.
6. Set aside one sample of apple for Part B.

Table A: Enzymatic Browning Observations

Fruit	0 minutes	10 minutes
Apple	White	Browned
Orange	Orange	Did not change
Banana	White	Browned

Conclusion:

1. Compare and contrast the fruits’ chemical reactions.
- The apple and banana both turned brown, but the orange stayed the same color.
2. Infer why this reaction is occurring in some fruit types and not others.
- The orange did not brown because it contains Vitamin C (ascorbic acid), an antioxidant. Vitamin C is also acidic, resulting in a lowered pH and inhibition of the browning process. Apples and bananas do not contain significant amounts of Vitamin C; therefore, oxidative browning occurred.
3. Remember to set aside the apple sample for Part B. The apple sample will serve as a *control* in the next investigation.

## PART B: Methods to Decrease Enzymatic Browning

### Lab Questions

Which of the following substances will decrease enzymatic browning on an apple?

Vitamin C
Cream of Tartar
Lemon Juice  
Sugar-water
Baking Soda
Vinegar
Salt water
Water

Choose two substances from above that your group believes will decrease enzymatic browning:

1. Vitamin C

2. Lemon Juice

Complete Table B with your choices and explanations. The substances you chose as having the ability to decrease enzymatic browning should be identified under the "Identity of Substance" column below.

Table B:

	Identity of Substance	Explanation
Sample A	Vitamin C or Cream of Tartar	The antioxidant properties will prevent oxidation from occurring.  The acidity of the substance will reduce the pH of the fruit, preventing oxidation from occurring.
Sample B	Lemon Juice or Vinegar	The acidity of the juice will reduce the pH of the fruit, preventing oxidation from occurring; the presence of antioxidants will also prevent browning.  The acidity of the vinegar will reduce the pH of the fruit preventing oxidation from occurring.

## MATERIALS

- |  |  |
|--|--|
| 2 household substances (based on prediction)                                 | 1 black permanent marker                   |
| ½ teaspoon measuring spoon (if applicable, based on substances chosen above) | 1 beaker or measuring cup containing water |
| 2 – 9 oz plastic cups  | 1 apple                                    |
| 2 plastic spoons   | 1 kitchen timer or stopwatch               |
| 1 paper plate (any size)   | Apple sample from Part A                   |
| 1 plastic or blunt knife   | Safety goggles                             |
|  | Aprons (optional)                          |

## PROCEDURE

1. Use the marker and draw a line dividing the paper plate into two sections. Label the sections: Sample A and Sample B.
2. Label one cup Sample A and the other Sample B.
3. Obtain and prepare the two substances from your prediction using the directions provided:

### Substance Preparation Procedures

- *Vitamin C Tablet*: Obtain 1 vitamin C tablet. Fill the cup ½ full of water. Crush the tablet before adding it to the water for better dissolution. Dissolve the tablet in the water.
  - *Cream of Tartar*: Obtain ½ tsp. of the cream of tartar in a 9 oz cup. Fill the cup ½ full of water. Stir the mixture until the cream of tartar has completely dissolved.
  - *Lemon Juice*: Fill one 9 oz cup ½ full of lemon juice.
  - *Sugar-Water Solution*: Obtain ½ tsp. of sugar in a 9 oz cup. Fill the cup ½ full of water. Stir the mixture until the sugar has completely dissolved.
  - *Sodium-Bicarbonate Solution (baking soda)*: Obtain 3 ½ tsp. of baking soda in a 9 oz cup. Fill the cup ½ full of water. Stir the mixture until the baking soda has completely dissolved.
  - *Vinegar*: Fill a 9 oz cup ½ full of vinegar.
  - *Salt Solution*: Obtain ½ tsp. of salt in a 9 oz cup. Fill the cup ½ full of water. Stir the mixture until the salt has completely dissolved.
  - *Water*: Fill a 9 oz cup ½ full of water.
4. Obtain and prepare your apple by cutting it in half. Place ½ of the apple in each of the two sections on your labeled plate. Make sure the flesh of the fruit is facing upward.
  5. Dip each fruit sample into the cup with the same label. For instance, the apple on the plate labeled *Sample A* should be dipped into the cup labeled *Sample A*.
  6. Allow the apple samples to sit for a total of 15-20 minutes (set your timer). While you wait, start Food Explorations Part II. Record your observations after 10 minutes and 20 minutes in Table C.

Table C: Color Change Observations

Sample	10 minutes	20 minutes
Sample A	Dependent upon sample choices. If one of the correct substances was chosen, there will be little to no color change observed; if not, browning will occur as it did in Part A.	See Sample A, 10 minutes
Sample B	See Sample A, 10 minutes	See Sample A, 10 minutes

## Conclusion:

1. Including the control (apple half from Part A), order each sample from greatest to least amount of enzymatic browning.

Greatest: Dependent upon chosen samples

\_\_\_\_\_

Least: \_\_\_\_\_

2. Compare and contrast the effectiveness of the substances you tested on inhibiting enzymatic browning.

Decreased enzymatic browning (effective): Vitamin C, Cream of Tartar, Lemon Juice, Vinegar

Increased enzymatic browning: Baking Soda

No Effect on enzymatic browning: Sugar-water, Salt Water, Water

3. As a class, discuss the list of substances used and complete the chart below:

Substance	Browning (Yes, None, Some)
Vitamin C	None
Cream of Tartar	None
Lemon Juice	None
Sugar-water solution	Yes or Some
Baking Soda	Yes
Vinegar	Some
Salt water	Yes or Some
Water	Yes

4. Consider the properties of the substances tested including acidic and basic properties. How might these properties impact the ability to decrease enzymatic browning?

Lemon juice, cream of tartar, and vinegar are all acids, which decreases pH and prevents enzymatic browning from occurring. Baking soda is a base, which will possibly increase the browning rate. Sugar-water, salt water, and water are all neutral substances that will have no effect on the reaction.

5. When making a fruit salad that includes apples and bananas, it is desirable to reduce the enzymatic browning of each fruit. Suggest a substance that could be used in the recipe for this purpose.

Lemon juice or cream of tartar