

APPLE BROWNING: A STUDY OF OXIDATION OF FOODS

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You are preparing for a small party of friends. One platter will be made up of cut pieces of fresh fruit, such as apples, pears, bananas, peaches, and more. You know, however, that on standing, the fruit tends to discolor, looking unappetizing. In this investigation, you will look at the browning reaction in apples and will be evaluating materials to retard this process. Since the materials used are added to retard the browning effect, they are considered to be food additives.

Materials Needed

Apples, red delicious or other varieties
Plastic knife
Stirring rod
Vitamin C, ascorbic acid, 0.1% solution in water and 1.0% solution in water
Citric acid, 0.1% solution in water
Acetic acid, 0.1% solution in water and 1.0% solution in water. (A 0.1% solution of acetic acid can be prepared by diluting 2.0 mL of vinegar (5% acetic acid) to 100 mL with water. A 1.0% solution of acetic acid can be prepared by diluting 20 mL of vinegar to 100 mL with water.)
Lemon juice
Salt, sodium chloride, NaCl
Sugar, sucrose
Paper plates, or paper towels

Safety

Safety glasses or goggles must be worn in the laboratory at all times.

If this experiment is performed in a chemistry laboratory, all work surfaces must be cleaned and free from laboratory chemicals. After cleaning work surfaces, it is advised to cover all work areas with aluminum foil or a food-grade paper covering.

All glassware and apparatus must be clean and free from laboratory chemicals. Use only special glassware and equipment, stored away from all sources of laboratory chemical contamination, and reserved only for food experiments is recommended.

Do not eat any of the materials used in this experiment unless specifically instructed to do so.

All the chemical reagents used in this experiment are sufficiently dilute that there are no safety hazards associated with the materials used in this experiment.

Disposal

Generally, all waste materials in this experiment can be disposed in the trash or poured down the drain with running water. All disposal must conform to local regulations.

Procedure

This experiment is performed as a class project.

Each group will need three slices of apple. The apple is sliced with a plastic knife to bruise it, speeding up the browning reaction.

One slice of apple, in each group will be untreated. This is your control.

One group will use the Vitamin C (ascorbic acid) solutions. Dip a slice of apple in each solution for 30 seconds. Place on paper plate or paper towels.

One group will use the citric acid solution and a solution made by diluting lemon juice 50% with water. Dip a slice of apple in each solution for 30 seconds. Place on paper plate or paper towels.

One group will use the acetic acid solutions. Dip a slice of apple in each solution for 30 seconds. Place on paper plate or paper towels.

One group will soak an apple slice in room temperature water for 30 seconds and a second slice in hot water for 30 seconds. Place on paper plate or paper towels.

One group will use salt and sugar. Lightly sprinkle salt on one slice of apple and lightly sprinkle sugar on a second slice of apple. Place on paper plate or paper towels.

Check the apple slices at 10 minute intervals, up to one hour. Record your information in the data table as: (use the bold printed words)

No browning

Slight browning or brown patches

Half covered light brown

Full covered light brown

Completely **dark** brown

Explanation

When fruits or vegetable are peeled or cut, enzymes in the plant tissue are exposed to the air. The enzyme *polyphenol oxidase* (phenolase), in contact with oxygen, catalyzes one step of the biochemical conversion of plant phenolic compounds to brown pigments known as *melanins*. This reaction is known as enzymatic browning and occurs at warm temperatures when the pH of the plant material is between 5.0 and 7.0. This reaction is also speeded up by the presence of iron (such as an iron or rusted knife) or copper (such as a copper bowl).

References

Apple Browning, *CHEMECOLOGY*, March 1992, Adapted from Chemical Education for Public Understanding Program (CEPUP) module, "Chemicals in *Foods: Additives.*", by the Regents of the University of California,

Institute of Food Technologists, *Enzymatic Browning of Apples*, IFT Experiments in Food Science Series, The society for Food Science and Technology, 1996.

Questions:

What causes browning in fresh fruits and vegetables which are peeled or cut?

What conditions speed up the browning process? How can you demonstrate this?

Which food additive(s) in the experiment performed the best.

Which food additive would you use if you were preparing a plate of cut fruit at home? Why?