I Screen, You Screen, We All Screen for Phenolics

Take a couple of bites from an apple or banana, put it down for a while, then go back and look at it. Is it brownish where you bit into it? Phenolic compounds (phenolics) in some fruits undergo oxidation in the open air causing the color change. In the presence of oxygen, enzymes in the fruits convert phenolics to quinones, which appear brown. Phenolics contribute to the flavor, acidity, and color of most fruits. There are many different phenolics and they have diverse chemical structures. Many are nutritious and healthful. The brown color in oxidized fruit is usually a sign that phenolics are present and will act in your body to prevent harmful oxidation.

Color tests are often used to find out whether particular chemicals are present (to “screen” for these chemicals). For example, test strips that change color when dipped into a solution with a high sugar content are used by diabetics to test their urine. This Activity uses a color test to screen for phenolics in several samples of grape juice prepared in different ways. When phenolics combine with iron(II) in neutral aqueous solution, a colored substance forms. The more phenolics there are in the juice sample, the more intense the color is—a color test result might be light brown or dark brown. Different types of phenolics also give different colors in the test.

Try This

You will need: grapes (any variety), hand-held garlic press, four polystyrene cups, marker, coffee filter, measuring spoon, dropper, cotton swabs, distilled water, juice sample (see step 8), solutions from your instructor: saturated solution of aqueous sodium bicarbonate (baking soda), 1% aqueous ammonium iron(II) sulfate reagent, phenolic standard.

1. Prepare 25 mL of grape juice from grapes. (If using red- or blue-skinned grapes, first remove the skins. Why might the skins interfere with the test results?) Place a peeled grape and any seeds in a hand-held garlic press and gently squeeze the juice from the grape into a polystyrene cup. Then discard the pulp and seeds and continue the process with another grape. Be prepared for squirting grape juice and sticky hands!

2. If the juice from step 1 contains any additional matter such as seeds or pieces of pulp, use a coffee filter to filter the juice into a new polystyrene cup.

3. Label two polystyrene cups “sample 1” and “sample 2”. Using a measuring spoon, transfer 2 teaspoons (10 mL) of the juice prepared in steps 1–2 into the cup labeled “sample 1”. Repeat with the cup labeled “sample 2”.

4. To neutralize the juice, add 1/2 teaspoon (2–3 mL) of a saturated solution of aqueous sodium bicarbonate (supplied by your instructor) to each sample. Swirl the cup to mix. Add additional saturated solution until there are no more escaping bubbles.

5. While swirling the cup, add 1–2 drops of 1% aqueous ammonium iron(II) sulfate reagent (supplied by your instructor) to each neutralized sample. Observe and record the color, intensity (darkness), and any other changes such as presence of a precipitate (insoluble solid).

6. Dip a separate cotton swab into each sample and let each swab dry. Label and save each swab (such as in a closed notebook) for future reference.

7. Mix 1 mL of a phenolic standard (supplied by your instructor) with 9 mL of distilled water in a dry, clean polystyrene cup. Repeat steps 5–6 with the standard sample (Note: the standard does not need to be neutralized, as in step 4.) Compare the intensity and color obtained with the first two juice sample results.

8. Repeat steps 4–6 with a new sample of grape juice prepared with a different processing method (use bottled or frozen concentrated grape juice, or juice extracted while pressing harder with the garlic press). Does the processing method affect the phenolic content?

9. Dilute the test solutions with tap water and discard according to your instructor’s directions.

Questions

1. When sodium bicarbonate is added to a sample, what causes bubbles? What does this suggest about a sample’s pH?
2. Describe the results of the color test. Include the color, the intensity (darkness), and whether a precipitate formed.
3. Does the processing method appear to influence the phenolic content? Explain.
4. Dried cotton swabs from step 6 can retain the same color you originally observed in the color test. How do the swabs provide a guide for testing done at a later date?
5. What is the purpose of the phenolic standard in step 7?

Information from the World Wide Web (accessed Sep 2005)

Phenolic compounds. http://www.biologie.uni-hamburg.de/b-online/e20/20d.htm
Color your way to 5 a day: blues/purples. http://www.cdc.gov/nccdphp/dnpa/5ADay/campaign/color/blues.htm