Red Cabbage Indicator

An Acid–Base Activity

Introduction

The pigments in red cabbage are excellent examples of natural pH indicators. With colors ranging from red to pink to violet to blue to green, they can brighten up any discussion of acids and bases. Most directions for preparing red cabbage indicator solution require boiling the cabbage in water. This easy recipe calls for a small amount of cabbage, water, a blender, and a strainer. No cooking and no strong odor involved!

Concepts

- Acids and bases
- Natural indicators
- pH

Materials

Red cabbage, one large outer leaf
Household substances, various (see *Tips*)
Water, distilled
Beaker or pitcher, 2-L
Blender
Beakers or plastic cups, clear, 250-mL capacity, 10
Stirring rod
Strainer or cheesecloth

Safety Precautions

Some household chemicals are toxic by ingestion or inhalation and are skin and eye irritants. Avoid contact of all solutions with eyes and skin. Clean up spills immediately. All food-grade items that have been brought into the lab are considered laboratory chemicals and are for lab use only. Do not taste or ingest any material in the lab and do not remove any remaining food items after they have been used in the lab. Wear chemical splash goggles, chemical-resistant gloves and a chemical-resistant apron. Wash hands thoroughly with soap and water before leaving the laboratory. Follow all laboratory safety guidelines.

Procedure *(Makes one liter of red cabbage indicator solution.)*

1. Remove one large outer leaf from a head of red cabbage (approximately 10 cm × 15 cm).
2. Tear the leaf into 1-inch pieces and place the pieces in a blender.
3. Add 1 L of distilled water to the blender.
4. Blend the cabbage until cabbage pieces are finely shredded. *Note:* The color of the blended cabbage juice will depend on the pH of the water. Tap water may not be neutral.
5. Place a strainer or cheesecloth over a large beaker or pitcher and pour the blended cabbage juice through the strainer. If neutral, the color of the red cabbage indicator solution will be bluish-purple.
6. Discard the solid cabbage in the strainer into the trash. *Note:* The red cabbage pulp will develop a pungent odor over time; you may want to place it in an airtight bag before discarding.
7. Set out nine clear beakers or cups.
8. Pour the reddish-purple cabbage juice into each of the nine beakers, distributing the solution evenly among them.
9. Set one beaker aside as a neutral reference.
10. Fill a tenth beaker just over halfway with distilled water for rinsing.
11. Add 10 mL of a liquid household substance to one beaker and stir. Note the color.
12. Rinse the stirrer in the beaker of distilled water.
13. Repeat steps 11 and 12 with other household substances. To test solid substances, add about 1 teaspoon of the solid substance to the cup.

Publication No. 10963
061616

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory wastes. Leftover solutions may be disposed of down the drain with an excess of water according to Flinn Suggested Disposal Method #26b.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
Evidence, models, and explanation
Constancy, change, and measurement
Content Standards: Grades 5–8
Content Standard A: Science as Inquiry
Content Standard B: Physical Science, properties and changes of properties in matter
Content Standard C: Life Science, structure and function in living systems
Content Standards: Grades 9–12
Content Standard A: Science as Inquiry
Content Standard B: Physical Science, structure and properties of matter, chemical reactions
Content Standard C: Life Science, matter, energy, and organization in living systems

Tips

- This activity is an easy and fun way to introduce acids and bases along with their application in industry, health, and the environment.
- This activity may also be used in a study of plant pigments. Try extracting other anthocyanins from beets or blueberries and determine their respective indicator colors.
- Below are suggested household substances for testing. These produce a beautiful spectrum of colors, with the soft drink, lemon, and vinegar both testing fairly acidic, salt testing neutral, baking soda testing slightly basic and ammonia and drain cleaner testing very basic.

Acids	**Bases**	**Neutral**
Clear soft drink	Ammonia, household	Salt
Lemon juice	Baking soda	
Vinegar	Bleach*	
	Drain cleaner	

*Bleach tests slightly basic, but it is easy to miss, since it quickly turns the indicator solution colorless—it is bleach after all!

- Red cabbage indicator solution will develop an odor and mold over time. Unused red cabbage indicator solution may be stored in a stoppered flask and refrigerated for up to one week.
- Dilute solutions (0.1 *M*) of hydrochloric acid and sodium hydroxide may be used as a comparison acid and base, respectively.
- Color charts for red cabbage extract are available from Flinn Scientific in a package of 30 (Catalog No. AP6847) and as an overhead transparency (Catalog No. AP6848).
- For an engaging lab activity that combines science and art using red cabbage indicator, see the student laboratory kit, *"Chem"-eleon Indicators*, available from Flinn Scientific (Catalog No. AP7018).

- A video of this demonstration, *Red Cabbage Indicator*, presented by Bob Becker, is available for viewing as part of the Flinn Scientific "Teaching Chemistry" eLearning Video Series. Please visit the eLearning Web site at http://elearning.flinnsci.com for viewing information. The video is part of the *Natural Indicators and Household Substances* video package.

Discussion

Red cabbage contains water-soluble pigments called anthocyanins. A solution prepared from red cabbage leaves acts as an indicator because it reacts with H^+ or OH^- ions present in various solutions and changes color depending on the pH of the solution. Figure 1 shows the range of colors of red cabbage indicator solution obtained at different pH values. Acidic solutions react with anthocyanins to produce reddish-pink colors, neutral solutions produce blue-violet hues, and basic solutions give green to yellow colors.

Color	Dark Pink	Rose	Lavender	Purple	Blue-violet	Blue	Blue-Green	Teal	Emerald	Greenish-yellow
pH	2	3	4	5	6	7	8	9	10	11–12

Figure 1.

Acknowledgment

Special thanks to Bob Becker, Kirkwood High School, Kirkwood, MO for sharing this activity with Flinn Scientific.

References

Forster, M. Plant pigments as acid–base indicators—an exercise for the junior high school. *Journal of Chemical Education*, **1978**, 55(2), 107–108.

Universal Indicator Red Cabbage Extract Color Chart, Flinn Scientific, Inc., Batavia, IL

Materials for *Red Cabbage Indicator* are available from Flinn Scientific, Inc.

Catalog No.	Description
AP4369	Blender, Single-Speed
AP7294	Cups, Clear Plastic, 10-oz, (pkg/50)
AP6227	Pitcher, Polypropylene, 2000 mL
H0014	Hydrochloric Acid Solution, 0.1 M, 500 mL
S0149	Sodium Hydroxide Solution, 0.1 M, 500 mL
AP6847	Universal Indicator Red Cabbage Extract Color Chart
AP6848	Universal Indicator Red Cabbage Extract Overhead Chart
AP7018	"Chem"-eleon Indicators—Student Laboratory Kit

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.