A Very Merry Indicator

Introduction

The bright red bracts of the poinsettia are not only a wintry pleasure but a great option to use as a natural indicator. In this activity, students extract the pigment from the poinsettia and use it as an indicator to identify the pH of unknowns.

Concepts

- Extraction
- Indicators
- pH scale
- Weak acid

Materials

Standard acid and base buffer solutions of known pH (pH 2–12), 5 mL each
Poinsettia bracts, about 5 g
"Unknown" acids and bases, 0.1 M, 5 mL each
- Acetic acid, CH_3COOH
- Ammonia, NH_3
- Ammonium nitrate, NH_4NO_3
- Phosphoric acid, H_3PO_4
- Sodium carbonate, $NaHCO_3$
- Sodium phosphate, monobasic, NaH_2PO_4
- Zinc nitrate, $Zn(NO_3)_2$
- Water, distilled or deionized

Beakers, 100- and 150-mL, 1 each
Colored pencils, 1 set
Pipets, Beral-type, 5
Reaction plate, 24-well

Safety Precautions

The standard acid and base solutions used in this experiment are body tissue irritants. Avoid contact of all chemicals with eyes and skin. 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.

Preparation. Extraction of Indicator

1. Obtain about 5 g of poinsettia bracts
2. Tear or grind the poinsettia bracts and place the pieces in a 150-mL beaker.
3. Cover the sample with distilled or deionized water (approximately 50 mL).
4. Heat the mixture just below boiling point using a hot plate or Bunsen burner setup.
5. After 15 minutes, decant or filter the mixture into a clean, 100-mL beaker. The indicator solution should be clear, not cloudy.

Procedure

Part A. Testing the Indicator

1. Add about 20 drops of a pH buffer into a well in the well plate. Repeat for all of the buffers.
2. Add 5 drops of the poinsettia indicator extract to each of the filled wells.
3. Record observations in by constructing a color chart of the buffers.

Part B. Testing Unknowns

1. Place 20 drops of each unknown into the wells of the well plate.

Publication No. 11062
061616

2. Add 5 drops of the poinsettia indicator to each of the unknowns.
3. Record observations into a data table and estimate the pH by referencing the color chart from Part A.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures, and review all federal, state and local regulations that may apply, before proceeding. All of the solutions may be flushed down the drain with excess water according to Finn 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
Constancy, change, and measurement
Content Standards: Grades 5–8
Content Standard B: Physical Science, properties and changes of properties in matter
Content Standards: Grades 9–12
Content Standard B: Physical Science, structure and properties of matter, chemical reactions

Tip

- This experiment reinforces the key concepts and definitions in the chemistry of acids and bases. The behavior of a natural indicator illustrates the definition of Brønsted acids (proton donors). The poinsettia extract can further be classi fied as a weak acid—it dissociates partially in water and its reaction with water is reversible. The different colors observed for the indicator reflect the position of equilibrium under different conditions.

Discussion

Indicators are dyes or pigments that can be isolated from various sources such as flowers, fruits and even fungi. The pigments in flowers that produce the colors are organic substances called anthocyanins and change color when exposed to different pH levels. Anthocyanins behave as weak acids—they can donate H^+ ions to H_2O molecules to form their conjugate base. The distinguishing characteristic of indicators is that the acid and conjugate base forms are different colors.

$$\underset{\text{Color A}}{Hln(aq)} + H_2O(l) \rightleftarrows \underset{\text{Color B}}{ln^-(aq)} + H_3O^+$$

The abbreviation Hln represents an unchanged indicator molecule and ln^- represents an indicator ion after it has lost a hydrogen ion. The color changes of acid base indicators illustrate an application of reversible reactions and equilibrium.

Reference

This activity was adapted from *Acids and Bases*, *Flinn ChemTopic™ Labs*, Volume 13; Cesa, I., Editor; Flinn Scientific Inc.: Batavia, IL (2006).

Materials for *A Very Merry Indicator* are available from Flinn Scientific, Inc.

Catalog No.	Description
B0227	Buffer Capsules, 2.00–12.00
A0096	Acetic Acid, 0.1 M, 1 L
A0290	Ammonium Nitrate, Gramolpack 0.1 M, pkg.
P0201	Phosphoric Acid, 14.8 M, 100 mL
S0235	Sodium Carbonate, 0.1 M, 500 mL
S0371	Sodium Phosphate, Monobasic 0.1 M, 500 mL
Z0026	Zinc Nitrate, 0.1 M, 500 mL
AP1516	Pipets, Beral-type, Graduated, Pkg./500
AP1447	Reaction Plates, 24-well

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