

Aspirin Tablets Can Differ

The principal ingredient in aspirin is acetylsalicylic acid (many medication tablets also contain a nontoxic, insoluble binder). If you have ever taken aspirin, you may have noticed some stomach discomfort afterward. Manufacturers have developed several techniques to make aspirin easier on your stomach. “Buffered” aspirin includes a buffer to lessen the effect of aspirin’s acidity in the already acidic environment of the stomach. Another advance involves coating the regular aspirin with a substance that prevents the tablet from dissolving until it reaches the basic environment in the small intestine; such aspirin is called enteric. This activity should help you understand how the above modifications to aspirin tablets help to minimize stomach discomfort.

Materials

- 3 regular aspirin tablets, such as Bayer or Anacin
- 3 buffered aspirin tablets, such as Bufferin or Bayer Plus
- 3 enteric aspirin tablets, such as Ecotrin or Bayer Enteric
- 3 clear, colorless glasses
- water
- 1-1/2 to 3 cups vinegar (enough to half-fill the 3 glasses)
- 3 teaspoons baking soda
- teaspoon measure

Exploration

- Step 1 Half-fill three glasses with water. Drop one regular aspirin tablet into the first glass, one buffered aspirin tablet into the second glass, and one enteric aspirin tablet into the third glass. Make note of the changes for each tablet at one-minute intervals for 5–10 minutes or until there are no further changes.
- Step 2 Repeat Step 1 using vinegar instead of water in the glasses.
- (a) What are the formulas of the 2 major components of vinegar?
 - (b) Is a significant difference noted for the tablets compared to Step 1?
 - (c) Explain.
 - (d) If any chemical reaction occurs, identify an obvious product.
- Step 3 Empty and rinse the 3 glasses, and half-fill them again with water. Add one teaspoon baking soda to each glass and stir to dissolve.
- (a) What is the chemical makeup of baking soda and is its aqueous solution acidic, neutral, or basic? Drop one regular aspirin tablet into the first glass, one buffered aspirin tablet into the second glass, and one enteric aspirin tablet into the third glass.
 - (b) Is a significant difference noted between the three different types of aspirin?
 - (c) How do these results compare to those from Steps 1 and 2?
 - (d) Do you use any of these three kinds of aspirin tablets?
 - (e) Will your preference change based on this activity?

Challenge

If modified forms of aspirin tablets behave differently in the digestive system, why do they do so?

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Concepts

acids, bases, and buffers

Expected Student Responses to Exploration

- Step 1 The regular and buffered aspirins readily “break up,” but the enteric aspirin does little.
- Step 2 (a) The major components of vinegar are water, H_2O (solvent), and acetic acid, $\text{HC}_2\text{H}_3\text{O}_2$.
(b) The behaviors are similar, except the buffered aspirin also bubbles.
(c) The bubbling results from the acetic acid in the vinegar reacting with the buffered tablet.
(d) The gas produced is probably CO_2 (because of a carbonate buffer).
- Step 3 (a) Baking soda is sodium bicarbonate, NaHCO_3 ; it forms a basic aqueous solution.
(b) Bubbles are observed because the basic nature of the solution reacts with the acetylsalicylic acid in the tablets to form gaseous CO_2 . The enteric tablet now breaks apart more readily because its coating is designed to dissolve in basic solution.
(c) Both the regular and buffered aspirins bubble as the latter did in Step 2. The enteric aspirin more readily “breaks up.”
(d) and (e) will vary with the individual student.

Expected Student Answer to Challenge

Buffered aspirin tablets contain a buffer that actually reacts with an acid, such as the acid found in the stomach. Enteric aspirin tablets are coated with a substance that will not dissolve in the acidic solution of the stomach, but will dissolve in the basic solution of the small intestine.

Reference

Kotz, Joesten, Wood, and Moore, *The Chemical World*, Chapter 16 (Acid-Base Titrations)

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