

Experiment 10

How Do You Spell Relief?

OUTCOMES

After completing this experiment, the student should be able to:

- perform a titration properly utilizing the available equipment.
- identify active ingredients commonly found in antacids.
- determine the relative effectiveness of different antacids by the volume of HCl they neutralize.

DISCUSSION

In this experiment, different brands of antacids will be titrated in order to determine which brand is the most effective. The volume of standard hydrochloric acid it will neutralize will determine the effectiveness of an antacid. The titration is one of the most common laboratory techniques utilized by chemists. It is a quantitative method usually used to determine the concentration of a solution having a known chemical composition. In some cases, a titration is used to determine the mass of a compound found in a solid sample. We will be doing the latter.

In a titration, the sample to be analyzed must be measured out. Solid samples are weighed on a balance, while liquid solutions are measured with a *pipet* (pipe-ETT). The samples are placed into a flask and some deionized water is usually added. Water is used to dissolve the samples and/or to provide a larger volume in which to observe any change in color. Many titrations also require the addition of an *indicator*. An indicator is a substance that changes colors at the *endpoint* — the point in the titration where the reaction is considered to be complete. Finally, a *standard solution* (a solution having an accurately known solute concentration and composition) is delivered with an instrument called a *buret* (byer-ETT). The buret is capable of delivering volumes of solution as small as one drop at a time. When the endpoint is reached, indicated by a change in color, the volume on the buret is read. Volumes may be read to the nearest 0.01 mL. The volume and concentration of the standard solution, and, if necessary, the volume of the unknown, are then used to calculate the unknown concentration or mass.

Gastric juices consist of dilute hydrochloric acid (around 0.1 *M*), as well as a number of digestive enzymes. Antacids are substances that are used to neutralize excess stomach acid in the event of heartburn or indigestion, often caused by overeating or eating spicy foods. The antacids must contain ingredients that are capable of neutralizing acids. Antacids are generally very weakly basic compounds that are insoluble in water. Strong bases, such as sodium hydroxide and potassium hydroxide, may be very effective in neutralizing acids, but exposure to the solid or concentrated solution forms of these substances can cause severe burns to the skin, eyes, and digestive tract.

Compounds commonly found in antacids include magnesium hydroxide, aluminum hydroxide, sodium bicarbonate, magnesium carbonate, calcium carbonate, and dihydroxyaluminum sodium carbonate, $\text{Al}(\text{OH})_2\text{NaCO}_3$.

Even though we will be determining the effectiveness of an antacid based only on the amount of hydrochloric acid it will neutralize, keep in mind that there are other factors to consider. Dosages of the antacids are given on the package labels and have been determined through medical research. Even if a single dosage of a particular antacid is capable of neutralizing more acid, it may be limited to fewer dosages per day.

The minerals present in antacids should also be considered. Calcium, sodium, and even magnesium are minerals known to perform essential life functions and are a normal part of everyone's diet. Some antacids even recommend regular usage as a dietary supplement. It should be noted that certain individuals, most notably those with high blood pressure, must carefully regulate their sodium intake. Aluminum, on the other hand, is also a mineral found in the body, but its function remains unclear. Abnormal concentrations of aluminum in the brain have been implicated in Alzheimer's disease.

Again, keep in mind that many factors must be considered in determining the overall long- and short-term effectiveness of an antacid. Still, the question remains, which antacid is capable of neutralizing the most acid? And, how do you spell relief?

PROCEDURE

- ⚠ Wear safety glasses or goggles at all times for this experiment.**
- ⚠ Avoid skin contact with the chemicals in this experiment.**
- ⚠ Handle the buret and other glassware carefully.**

1. Pick up an antacid tablet from your instructor (do not use dark pink tablets). What is the active ingredient found in the antacid and how much it is there in a single tablet? Measure and record the mass of the tablet. Place the tablet in a 250 mL Erlenmeyer flask and add 25 mL of deionized water. Set it aside for a few minutes. Then use a spatula or stirring rod to finely crush the tablet. Most antacids will not dissolve to a great extent. Add 10 drops of methyl orange indicator solution to the flask.
2. Obtain a clean buret and rinse it out with a small portion of the standard hydrochloric acid. Run some of the acid through the tip by turning the stopcock so it is parallel to the tip. Mount the buret on a stand and fill it with the 0.50 M HCl solution. Drain some of the HCl from the buret, bringing the level to the zero mark or below and making sure that all air bubbles have been removed from the tip. Record the concentration (0.50 M) of the standard HCl and the level of the liquid in the buret.

3. Move the flask under the buret and place a white sheet of paper under the flask. Open the stopcock and slowly add acid to the flask. Swirl the contents of the flask while the acid is being added. As you continue with the titration, you will notice the color of the indicator begin to change. At this point, begin to slow the rate at which the acid is added. When you near the endpoint, the addition of each drop will turn the solution pink, which may disappear with swirling. Add a single drop of acid at a time, swirling after each drop, until the pink color persists for more than 30-60 seconds. Note that the final color may be different if a colored tablet was used. Record the final buret reading. Use the initial and final buret readings to determine the total amount of HCl added.
4. Obtain an antacid tablet of a different strength or brand and repeat the above procedure.
5. Collect and record the results obtained by at least 4 other groups for each antacid available. Calculate the average volume of HCl used for each antacid.

⚠ *Dispose of all chemicals in the proper waste container.*

Your Name _____

Lab Section _____

Partner's Name _____

DATA

	Trial 1	Trial 2
Antacid brand		
Active ingredient		
Mass of active ingredient		
Mass of tablet		
Molarity of standard HCl		
Final buret reading		
Initial buret reading		
Volume of HCl used		

Antacid Brand		
Volumes of HCl used by each group		
Average Volume of HCl used		

