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Sugar Content in Beverages

Density Analysis

Introduction

Nutritionists have recently raised concerns about the increasing popularity of sodas, fruit drinks, and other beverages due to their high sugar content. Do you know how much sugar is in your favorite beverage?

Concepts

• Density • Solution • Concentration • Calibration curve

Background

The density of a *solution* depends on its *concentration,* that is, how much solute (solid) is dissolved in the solvent (liquid). If the density of a solution is plotted on a graph against the concentration of solute, a regular pattern is evident density is proportional to concentration. The resulting graph, called a *calibration curve,* shows a straight-line relationship between the density of a solution and the concentration of solute. A calibration curve can be used to determine the concentration of solute in an unknown solution whose density has been measured.

The purpose of this cooperative class activity is to measure the densities of popular beverages and determine their sugar contents using a calibration curve obtained by plotting the densities for a series of reference solutions versus percent sugar. The experimentally determined percent sugar for the beverages will be compared against the information provided on their nutritional labels to evaluate the accuracy of this method.

Hypothesis

How well does the sweet taste of a beverage correlate with the amount of sugar it contains? Based on your *memory* of their taste, predict the relative sugar content in the following beverages: cola, grape juice, and sports drink. (Rank the beverages from 1, highest sugar content, to 3, lowest sugar content.) Place your hypothesis below your purpose in your lab report

Materials

Beverages (at room temperature)* Graduated cylinder, 25-mL
Balance, centigram (0.01 g) precision Thermometer
Beakers or plastic cups, 250-mL, 2

** Any carbonated beverages must be "flattened" to remove dissolved carbon dioxide before testing. This can be accomplished by pouring the beverage back and forth from one container into another several times until it stops fizzing.*

Safety Precautions

Although the materials in this activity are considered nonhazardous, follow all normal laboratory safety guidelines. Anyfood-grade items that have been brought into the lab are considered laboratory chemicals and are for lab use only. Do not tasteor ingest any materials in the laboratory, and do not remove any food items from the lab after use. Wear safety glasses or chemicalsplash goggles whenever working with chemicals, heat or glassware in the lab. Wash hands thoroughly with soap and waterbefore leaving the lab.

Soda Lab Procedure:

Before beginning the lab record the kind of beverage (soda/juice/sport drink) and the brand of beverage (Mt. Dew, Kroger Apple, Gatorade) in your data section.

Then.....

1. Find the mass of a clean 20 - 25 ml graduated cylinder. (Empty) Record this as the mass of empty cylinder.

2. Fill the graduated cylinder up to the 10.0 ml mark with your selected beverage. (soda/juice/sport drink) Make sure you measure the volume from the bottom of the meniscus and record to the nearest 1/10th (0.1) of a milliliter.

3. Now find the mass of the cylinder + the beverage. Record this as the mass of cylinder + 10 mls.

4. Calculate the mass of the beverage by subtracting the mass of the empty cylinder from the Cylinder + beverage. Record in your data.

6. Calculate the density of your beverage. Remember to follow the rules for significant digits.
Density = mass/ volume

DO NOT DUMP OUT THE SODA/JUICE OR SPORT DRINK!!!!!

7. Add 10 more mls of soda, juice, or sport drink to the same cylinder so that it now reads around the 20 ml mark. Record the new volume in your data.

8. Now find the mass of the cylinder + beverage and record.

9. Calculate the mass of thebeverage alone.

10. Calculate the Density of your beverage by taking the new mass and dividing it by the new volume. Again remember to follow the rules of significant digits.

11. Are the densities of your first and second trial similar?

12. Find the average density and record.

13. Using a thermometer, record the temperature of your beverage in your data section

Sample Data table
Beverage _____ Brand _____

	Trial 1	Trial 2
Mass of cylinder	____	_____
Mass of cylinder + Beverage	_____	_____
Mass of Beverage	_____	_____
Volume of beverage	_____	_____
Density of beverage	_____	_____

Average Density _____

Questions

1. Using the calibration curve provided by your teacher, use the density of your drink to determine the % sugar in the beverage.
2. Obtain class data and record here

Soda Juice Sport Drink (leave room to record data)

3. How precise were the measurements? (Discuss each category) Which group was the most precise? the least precise?
4. Find the average % sugar for each each category.
5. Which category *on average* had the most sugar?
6. Given the actual % sugar for your results (#1) calculate the percent error for your experiment.|

$$\% \text{ error} = \frac{|\text{Exp} - \text{True}|}{\text{True}} \times 100$$

7. What is the relationship between density and % sugar?
   (linear direct, Linear inverse, direct, or inverse)

IV Error Sources:

This lab examines the relationship between the density of a beverage and its sugar content. What assumption is being made about the other ingredients and their effect on density? It this a valid assumption? What are some other errors that could have influenced the outcome of your results/

V) Conclusion: Was your hypothesis correct? Was your results (for your chosen beverage) precise? accurate?