VITAMINS

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Vitamins are biomolecules necessary in small amounts

- Needed for growth, reproduction, health and life
- Quantity required is 0.2 g daily
- Chemical substances needed other than fats, proteins and carbohydrates
- Scurvy is an example of a disease caused by a Vitamin C deficiency.

Two classifications:

1. Fat soluble – absorbed from the intestine with assistance of fats
   - Stored in body fat
   - Not necessary to consume daily
     - can become toxic if taken in large quantities

2. Water soluble – absorbed from the intestine with assistance of water
   - Not stored in the body
   - Must consume daily
     - cooking washes away or destroys some of them
     - do not become toxic

RDA's (Recommended Daily Allowance) – depends on your age and gender

To eat a nutritionally balanced diet, one thing you must know is which foods deliver adequate amounts of the vitamins you need. It is good to build a diet around *a variety* of foods to help attain the adequate amounts of vitamins.

Experiment: Quantifying Vitamin C

Vocabulary:

- **Vitamin C** – ascorbic acid, one of the least stable vitamins (destroyed by heat, light and oxygen)

- **Titration** – technique used to find concentration of a solution or the amount of a substance in a sample

- **Endpoint** – color change – indicates that a titration reaction is complete

Background: Vitamin C, also known as ascorbic acid, is a water-soluble vitamin. It is among the least stable vitamins, meaning that it reacts readily with oxygen and so its potency can be lost through exposure to light and heat. In this experiment we will investigate how the type of storage may affect its concentration. The analysis for vitamin C is based on the chemical properties of ascorbic acid and iodine. Iodine (I_2) solution is capable of oxidizing ascorbic acid, forming the colorless products dehydroascorbic acid, hydrogen ions (H^+), and iodide ions (I^-):

$$I_2(aq) + C_6H_8O_6(aq) \rightarrow C_6H_6O_6(aq) + 2\,H^+(aq) + 2\,I^-(aq)$$

Iodine	Ascorbic acid (vitamin C)	Dehydroascorbic acid	Hydrogen ion	Iodide ion

Using **titration**, a laboratory procedure used for finding the concentrations of substances in solutions, the amount of vitamin C can be determined. A known amount of one reactant is added slowly from a buret to another reactant in the receiving vessel until just enough is added for a complete reaction. The completed reaction is recognized by a color change or **endpoint**. If the reaction involved is known along with the concentration of one reactant, then the unknown concentration of the second reactant can be calculated using the concentration and volume of the other reactant.

In this procedure, the endpoint is signaled by the reaction of iodine with starch, producing a blue-black product. Starch is added to a known volume of the beverage (second reactant in receiving vessel) to be tested then an iodine solution (known concentration) is slowly added from the buret. As long as ascorbic acid is present, the iodine is quickly converted to iodide ions, and no blue-black iodine-starch product is observed. However, when all the available ascorbic acid has been oxidized, the next drop of added iodine solution reacts with starch and you will see the blue-black color. Thus the endpoint in the titration is the permanent blue-black color (color maintained for 20 seconds) in the beverage-containing flask.

You will first complete a titration with a known vitamin C solution, which will allow you to find a useful conversion factor for finding the mass of ascorbic acid that reacts with each milliliter (mL) of iodine solution. You can then calculate the mass of vitamin C present in a 25-mL sample of each treatment.

Prepare a data table like the one below in your laboratory notebook.

Data Table

Treatment	mL Iodine Solution Used (from Part 3)	X	Conversion Factor (from Part 2)	= mg Vitamin C per 25 ml.	Rank highest to lowest in Vit. C
1.		X		=	
2.		X		=	
3.		X		=	
4.		X		=	
5.		X		=	

Procedure

Part 1. Treatments

1. Select a beverage (preferably light in color such as apple juice or white grape juice).
2. Equally divide into three volumes and remove enough to measure Vitamin C at beginning of study. Place one volume in sealed container stored in dark refrigerator; place another in dark sealed container at room temperature; and the other in light penetrating sealed container at room temperature. Let set until another class period. (Another set of treatments could be added where unsealed containers are used.)

Part 2. Determining Conversion Factor

1. Place 25.00 mL of a vitamin C (ascorbic acid) solution of a known concentration into a 125-mL Erlenmeyer flask.
2. Add 10 drops of 1% starch suspension.
3. Fill a clean buret with iodine solution and record the starting volume to the nearest 0.01 mL.
4. Slowly add iodine solution to the flask as you gently swirl it. Continue until the endpoint is reached (when the first sign of blue color remains after at least 20 seconds of swirling). A piece of white paper placed under the flask will help you recognize the color.
5. Record the final buret volume to the nearest 0.01 mL. Calculate the volume of iodine solution used in the titration.
6. Calculate the number of milligrams of vitamin C that corresponds to 1.00 mL of iodine solution. This can be found by dividing total mg of vitamin C in flask by the volume (in mL) of iodine solution used in the titration.
7. Record your calculated value in the "Conversion factor" column of your data table. (The factor has the units, mg vitamin C per mL I_2 solution).

Part 3. Analyzing Treatmentss for Vitamin C

Follow the procedure below for each treatment.

1. In triplicate, measure 25.00 mL of each juice treatment into a 125-mL Erlenmeyer flask.
2. Follow Steps 2 through 5 in Part 2.
3. Write the calculated volume of iodine solution used in the titration in your data table. Also, enter the conversion factor value from Part 2.
4. Use the formula to find the mass (mg) of vitamin C in the sample.
5. Finally, determine the treatment effects if any on vitamin C concentration.

Questions:

1. Among the treatments tested, were vitamin C levels affected?

2. If so, what is your recommendation of storage conditions for juices containing Vitamin C.

3. What other common foods contain a high level of vitamin C?