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Extraction and Investigating Acidity of Fruit Juices and Vegetables Using Titration

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Abstract: *This study aimed to extract and investigate the acidity of various fruit juices and vegetables using titration. The acidity of different samples which I get including lemon, orange, apple, and tomato, was determined by reacting them with a strong base, sodium hydroxide (NaOH), and measuring the volume of base required to neutralize the acid. The extraction process is some involved juicing the fruits and vegetables, followed by filtration to obtain clear samples. The pH values of the samples were measured using a pH meter, and the acidity was determined by titration with NaOH. results showed approximately significant variations in acidity among the tested samples, with lemon exhibiting the highest acidity level. In this experiment The pH values of the samples were also measured and correlated with the titration data. . The findings have implications for food science, nutrition, and the development of new products. Additionally, this project provides a valuable educational experience in analytical chemistry techniques. Considering the experiment on extracting and investigating the acidity of fruit juices and vegetables using titration, here are some useful product ideas: Household and Cleaning Natural cleaning products: Develop natural cleaning products, such as all-purpose cleaners or disinfectants, with optimal acidity levels for effectiveness. pH-neutral cleaning solutions: Create cleaning solutions with optimal acidity levels to prevent damage to surfaces. Drain cleaners: Use the knowledge of acidity levels to develop effective drain cleaners.*

Keywords: acidity, titration, fruit juices, vegetables, pH, natural cleaning products, food science.

I. INTRODUCTION

It is important in a number of everyday items, such as orange juice, that the citric acid be quantitatively measured. Industries manufacturing juice products must know the amount of juice, both for regulatory purposes (FDA) and for their own manufacturing specifications. They can quantitatively determine the amount of juice by measuring the amount of citric acid. The procedure commonly used to do this takes advantage of the known reactivity of citric acid with sodium hydroxide and is known as a titration.

A titration is a means of quantitative analysis in which the substance to be measured (in a liquid solution) is reacted stoichiometrically with another reagent (called a titrant) until it has completely reacted. The end of the reaction is usually signaled with the appearance of a color from another non-interfering substance called an indicator. In the case of the citric acid titration, a known amount of orange juice is measured into an Erlenmeyer flask with an indicator solution containing phenolphthalein (the indicator). Sodium hydroxide, at a known concentration, is then carefully added into the sample until all of the acid has reacted. When all of the acid has completely been neutralized, the addition of 1 additional drop of the sodium hydroxide solution, the titrant, causes the solution to become basic. The basic solution will be marked by the appearance of a pinkish color in the solution of orange juice.

The device used to add the titrant (NaOH) to the juice sample is called a buret. It allows us to measure the exact amount of solution added during the titration. Knowledge of this, the concentration of NaOH solution in moles/liter, and the known stoichiometry of the reaction allows us to calculate the citric acid concentration in the juice sample

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II. METHODOLOGY

1. Sample Collection: Fresh fruit juices (e.g., orange, apple, and grapefruit) and vegetables (e.g., tomatoes, cucumbers, and carrots) will be collected from local markets.
2. Sample Preparation: Fruit juices will be filtered to remove pulp and sediment, while vegetables will be juiced using a juicer.
3. Titration: A standardized titration protocol will be used to measure the acidity of each sample. Sodium hydroxide (NaOH) will be used as the titrant.
4. PH Measurement: The pH of each sample will be measured before and after titration using a pH meter.
5. Data Analysis: The acidity levels of each sample will be calculated and compared using statistical analysis.

Pre - Titration Preparation.

1) standardization: Standardize the sodium hydroxide (NaOH) sol" by by titrating it against a known acid (eg grapes)
2) Prepare Indicator: Phenolphthalein and methyl orange indicator.
3) Calibration of PH meter: calibrate the PH meter.

Titration:

1) Prepare a 0.1 M sodium hydroxide (NaOH) solution as the titrant.
2) Pipette lo ml of the sample into a conical fiask.
3) Add 2-3 drops of phenolphthalein indicator to the Sample
4) Titrate the sample with NaoH solution until the endpoint is reached.

6) PH measurement:

1) Measure the pH of each sample before. and after fitration using a pH meter.

Calibrate the pH meter before use.

7) Data Analysis:

1. calculate the acidity of each sample. using the following formula:

Acidity (g/100ml) = Volume of NaoH Molarity of NaoH X M X Equivalent weight of Acid/volume of sample

2) compare the Acidity level of different sample.

III. LITERATURE REVIEW

The extraction and investigation of acidity in vegetables and fruits using titration have a rich history, dating back to the 18th century. Over the years, scientists have developed and refined titration methods, leading to a deeper understanding of acidity in various food products. Acidity is an essential parameter in determining the quality and nutritional value of fruits and vegetables. Titration is a widely used method for measuring acidity, involving the reaction of a strong acid or base with a sample until the acid or base is fully neutralized.

Methods for Extraction and Titration

1. Sample preparation: Fruits and vegetables are typically homogenized, juiced, or extracted with solvents like water or ethanol to release their acidic components (1).
2. Titration methods: Various titration methods have been employed, including acid-base titration, potentiometric titration.
3. PH indicators: pH indicators like phenolphthalein are often used to determine the endpoint of titration (3).

Studies on Acidity in Fruits and Vegetables

1. Citrus fruits: Titration has been used to determine the acidity of citrus fruits like oranges, lemons, and limes, with citric acid being the primary acidic component (4).2. Tomatoes: The acidity of tomatoes has been investigated using titration, revealing a significant decrease in acidity during ripening (5).

Factors Affecting Acidity

1. Ripeness: The acidity of fruits and vegetables can change during ripening, with some becoming more acidic and others less acidic (7).
2. Variety: Different varieties of fruits and vegetables can exhibit varying levels of acidity (8).
3. Environmental factors: Environmental factors like temperature, soil quality, and climate can influence the acidity of fruits and vegetables

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IV. RESULT AND DISCUSSION

Result-

This study successfully extracted and investigated the acidity of various fruits and vegetables using titration. The results showed significant variations in acidity levels among the different samples, with citrus fruits exhibiting the highest acidity values. The findings of this study provide valuable information on the acidity levels of various fruits and vegetables, which can be used to predict their stability, shelf-life, and suitability for various culinary and processing applications.

PH Meter. Preparation / Measuring PH

PH range: I found that different fruit Juices exhibited levels. Wide range of Ph levels.

Fruit sample.	PH level	Acid
1) cucumber	6.20	citric Acid
2) orange	4.56	Citric Acid
3) Tomato	4.40	oxalic Acid
4 Lemon	3.56	Citric Acid
5) Grape	3.82	Tartaric Acid
6)Apple	3.37	Malic Acid
7)carrot	6.01	Citric Acid

PH scale: The PH scale ranges from 0 to 14, with:
PH 0-1: Strongly Acidic
PH: 2-3 Acidic
PH: 4-5 Weakly Acidic PH 6-7 Neutral
PH: 8-9 Weakly Basic.
PH 10-14: Basic

Discussion

The results of this study are consistent with previous research, which has reported that citrus fruits tend to be more acidic than other fruits and vegetables (1, 2). The acidity levels of the fruits and vegetables extracted in this study can be attributed to the presence of various organic acids, such as citric acid, malic acid, and tartaric acid. The acidity levels of the fruits and vegetables can impact their nutritional and culinary value. For example, acidic fruits and vegetables may have higher antioxidant activity and health benefits due to the presence of polyphenolic compounds (3). On the other hand, high acidity levels can also impact the texture and flavor of fruits and vegetables, making them more suitable for certain culinary applications.

V. CONCLUSION

This study successfully extracted and investigated the acidity of various fruits and vegetables using titration. The results showed significant variations in acidity levels among the different samples, with citrus fruits exhibiting the highest acidity values. The findings of this study provide valuable information on the acidity levels of various fruits and vegetables, which can be used to predict their stability, shelf-life, and suitability for various culinary and processing applications.

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