EXPERIMENT 1 DETERMINATION OF ACIDITY AND pH

Structure

1.1 INTRODUCTION

Acidity of foods is usually determined by acid, base titration using standard sodium hydroxide. The reaction being between a weak acid and a strong alkali, phenolphthalein is used as the end point colour indicator, which produces a faint pink colour around pH 8. For dark coloured solutions, alkali titration can be carried out to pH 8.1 using a pH meter.

pH of foods is determined using a pH meter having glass electrode and calomel electrode or a combination electrode.

Objectives

After studying and performing this experiment, you should be able to

- determine the acidity of food products by alkali titration; and
- determine the pH of the product using a pH meter.

1.2 EXPERIMENT 1a: DETERMINATION OF ACIDITY

1.2.1 Principle

Organic acids react with sodium hydroxide to form their corresponding sodium salts. The common organic acids are mono- carboxylic (acetic acid, lactic acid), dicarboxylic (malic and tartaric acids) and tri- carboxylic (citric acid) acids. The general reaction between an organic acid and sodium hydroxide is as follows.

$$R–(COOH)n + n\ NaOH = R–(COONa)n + n\ H_2O$$

By knowing the equivalent weight of the acid, the acid content can be calculated based on the alkali required for neutralization.

1.2.2 Requirements

Equipment and Apparatus

Chemical balance	
Conical flask – 250 ml	–3
Beaker – 100 ml	–1
Volumetric flask – 100 ml	–1
Burette – 10 ml	–1
Pipette – 5 and 10 ml	–1 each

Chemical and Reagents

Sodium hydroxide solution – 0.1 N

Phenolphthalein indicator – 0.1% in alcohol

1.2.3 Procedure

Acidity determination
Sample preparation

Thin Juices, RTS beverages etc.: Mix thoroughly and filter through previously washed and dried muslin cloth. Use 5-10 ml for titration.

Fresh fruits & vegetables, dried fruits, preserves, jams, marmalades pickles etc.: Pulp the material in a blender or mortar and mix thoroughly. Accurately weigh 10 to 20 g of the pulped material in a beaker, add about 50 ml distilled water and boil gently for 15 to 30 min replacing the water lost by evaporation. Cool, transfer to a volumetric flask (say 100 ml) and make up the volume. Filter through Whatman No.1 filter circle, if necessary.

Fruit pulps, squashes, syrups, cordial etc.: Weigh 10-20 g of the material, mix with distilled water, heat on steam bath to dissolve, cool and make up the volume in a volumetric flask (say 100 ml).

Pipette out suitable aliquot (5-10ml) of the prepared sample (quantity depending on the acidity of the sample) into a 250 ml. conical flask. Add about 50 ml of distilled water and few drops of phenolphthalein indicator. Titrate to light pink end point with 0.1 N NaOH solution. Products like juices and beverages may be directly weighed (5-10g) and transferred into 250 ml conical flask with about 50 ml distilled water and titrated.

1.2.4 Observations

Where samples are boiled with water and made up to volume:

Weight of sample	= W	= ---------- g
Volume made up to	= V_1	= ----------ml
Volume of aliquot taken for titration	= V_2	= ----------ml
Volume of NaOH required	= V_3	= ---------- ml
Normality of the NaOH solution	= 0.1	

Where sample is weighed and directly taken for titration:

Weight of sample = W_1 = ---------- g

Volume of NaOH required = V_4 = --------- ml

Normality of the NaOH solution = 0.1

1.2.5 Calculations

1000 ml 1N NaOH = One gram equivalent of organic acid.

Calculate the acidity in terms of the predominant acid present in the product. The equivalent weights of some common organic acids and the foods in which they are the major acids are given below. However, unless specifically required, it is customary to calculate the acidity of food materials as anhydrous citric acid.

Organic acid	**Equivalent Wt. (E.W.)**	**Foods**
Anhydrous citric acid	64	Citrus fruits
Malic acid	67	Raw mango, apple
Tartaric acid	75	Grapes, tamarind
Lactic acid	90	Milk foods
Acetic acid	60	Vinegar containing foods

For samples boiled with water and made up to volume:

$$\% \text{ acid} = \frac{\text{E.W. of acid} \times \text{Titer} \times \text{Normality of NaOH} \times \text{Volume made up} \times 100}{1000 \times \text{Aliquot taken} \times \text{Weight of sample}}$$

$$= \frac{\text{E.W. of acid} \times V_3 \times 0.1 \times V_1}{10 \times V_2 \times W}$$

For sample taken directly for acidity estimation:

$$\% \text{ acid} = \frac{\text{E.W. of acid} \times V_4 \times 0.1}{10 \times W_1}$$

For carbonate beverages, expel carbon dioxide by warming or just heating to boil, cool and then titrate.

1.2.6 Result

Acidity of the given product = Percent (w/w)

1.3 EXPERIMENT 1b: DETERMINATION OF pH

1.3.1 Principle

Acidity of any solution is dependant on the pH and in turn pH depends on the Hydrogen ion concentration of solution. pH can be calculated by the equation pH = negative logarthim of Hydrogen ion concentration i.e.,

$$pH = -\log (H^+)$$

1.3.2 Requirements

pH meter

Buffer solutions – pH 4.0, 7.0 and 9.0

1.3.3 Procedure

Sample preparation

Liquid samples are used as such for pH measurement. Solid and semi-solid materials have to be homogenized well before the measurement.

Procedure

The pH meter should be switched on for at least 30 min before taking measurements for stabilization. The pH meter is calibrated against standard buffers before measuring the pH of sample. pH meters are provided with operating instructions, which should be followed. Rinse the electrode(s) with water and wipe dry using a filter paper in between buffer and sample pH measurements.

1.3.4 Results

The pH of the sample is recorded usually to the first decimal place

1.4 PRECAUTIONS

The general precautions mentioned in the course 'Introduction' and those indicated in the experiments should be followed meticulously.