

SHORT COMMUNICATION

Green alternative to Synthetic indicator in acid-base Titrations

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ABSTRACT

The standard synthetic indicators employed to locate the end point in a neutralization titration are generally weak organic acids or bases. Replacement of synthetic indicators by easily available, low cost, benign natural indicators is the need of the hour. The bright colour of floral, fruit or root peel extracts is attributed to certain pigments. Using this property, an attempt has been made to use the natural extracts as substitute for synthetic acid-base indicators. Comparative studies with standard indicators reveal high degree of accuracy and end points are sharp, intense colours.

Keywords: neutralization, indicators, , extracts , pigments.

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INTRODUCTION

Acid-base indicators are generally weak organic acids or bases which upon dissociation or association undergo structural changes that give rise to alteration in colour. A solution containing an indicator will show continuous changes in colour with variation in pH [1]. The subjective colour change involve a major alteration in the position of the indicator equilibrium. Certain species of plants bearing bright coloured outer peels can be employed for the purpose of locating end point [2]. Onion (*Allium cepa* L.) is one of the oldest and most frequently cultivated food plants highly valued for its pharmacological properties.

Allium cepa , is a major source of Anthocyanines. Red onions owe their colour mainly to anthocyanins from the epidermal cells of the scale leaves of the bulb [3]. Natural textile colorant has not been exploited so far to its full extent. It is investigated to give satisfactory results comparable to routinely used synthetic indicators [4]. Extraction of peel into minimal volume of ethanol isolates the pigment so as to use as indicator in acid-base titrations⁵. The rationale behind present study is to tap the feasibility of natural indicators in routine classical acid-base titration methods that replaces synthetic indicators successfully [6].

EXPERIMENTAL

Calibrated sets of glassware are made up of Pyrex or corning were used throughout the analysis. An analytical balance of 0.001 g sensitivity was used for weighing the samples. An Elico Li 120 Ph meter was used for pH measurements.

Plant Materials-

Dry peels of *Allium cepa* (Onion) were collected from the local vegetable trading market. Analytical grade reagents like Hydrochloric acid (HCl), Sodium hydroxide (NaOH), Acetic Acid (CH₃COOH), Phenolphthalein & Methyl Orange were procured from Smt. C.H.M College, Ulhasnagar-3. Reagents and volumetric solutions were prepared as per Indian Pharmacopoeia (I.P.1996).

Preparation of extract

The dry peels of red onions were cleaned by distilled water and cut into small pieces and macerated for four hours and anthocyanins were extracted at 30°C, overnight using solvent system, ethanol: water(80:20) . The extract was preserved in tightly closed container and stored in dark. The pigments in the extract separated by Thin Layer Chromatography – a technique similar to paper chromatography. The buffer system in pH range 1-14 was prepared using potassium dihydrogen phthalate.

Titration system:

The natural extract treated as acid-base indicator for strong acid-strong base (0.1NHCl & 0.1N NaOH) system, Weak acid-strong base system (0.1 N CH₃COOH & 0.1N NaOH), strong acid- Weak base (0.1NHCl.

& 0.1N NH₃) system and mixed acid-strong base system (0.1NHCl+ 0.1 N CH₃COOH& 1N NaOH).(Table1).Comparative study with standard indicators phenolphthalein and methyl orange was carried out.(Table2&3)

10 cm³ of titrant with addition of two drops of natural indicator was titrated with respective titrates. The colour changes observed were tabulated. Reproducibility was checked by carrying out each titration for three times.

RESULTS AND DISCUSSION

The equivalence point obtained with Allium cepa indicator for each system of titration when compared with same titration system using phenolphthalein, it almost coincided (relative error -0.2%). These natural extract give satisfactory results comparable to routinely used synthetic indicators with same degree of accuracy. Extraction of onion peel into minimal volume of ethanol isolates the pigment so as to use as indicator in acid-base titrations. The proposed indicator is inexpensive, acts reversibly and imparts sharp colour change at equivalence point. Thus from green chemistry point of view, this indicator can be successfully employed for routine acid-base titrations.

Table 1: Colour change at equivalence point using AC extract

Titrant	Indicator	Colour	Titrate	Colour
0.1N HCl	AC	colourless	0.1N NaOH	Golden Yellow
0.1N HCl	AC	colourless	0.1N NH ₃ soln.	Golden Yellow
0.1N CH ₃ COOH	AC	colourless	0.1N NaOH	Golden Yellow
0.1N HCl + 0.1N CH ₃ COOH	AC	colourless	0.1N NaOH	Golden Yellow

AC:Allium cepa extract

Table 2: Comparative study with std. indicators

Titrant	Indicator	Colour	Titrate	Colour
0.1N HCl	Phenolphthalein	Colourless	0.1N NaOH	Pink
0.1N HCl	Phenolphthalein	Colourless	0.1N NH ₃ soln.	Pink
0.1N CH ₃ COOH	Phenolphthalein	Colourless	0.1N NaOH	Pink
0.1N HCl + 0.1N CH ₃ COOH	i) Methyl Orange ii) Phenolphthalein	i) Pink ii) Yellow	0.1N NaOH	i) Yellow ii) Green

Table 3: Volume of titrate recorded at equivalence point

Titrant	Titrate	Std. ind.	AC
0.1N HCl	0.1N NaOH	10.2±0.2cm ³	10.3±0.2cm ³
0.1N HCl	0.1N NH ₃ soln.	9.9 ±0.2cm ³	9.7 ±0.2cm ³
0.1N CH ₃ COOH	0.1N NaOH	9.6±0.3 cm ³	9.4 ±0.1 cm ³ cm ³
0.1N HCl + 0.1N CH ₃ COOH	0.1N NaOH	9.1±0.3 cm ³	8.9±0.2 cm ³

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