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Research Article

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Use of *Basella alba* fruit extract as a potent natural acid-base indicator

[*]Asish Mitra[a] and Sanat Kumar Das[b]

[a]Department of Chemistry, Maharaja Bir Bikram College, Agartala, Tripura (West)
[b]PGT (Chemistry) Shalgara H.S School, Udaipur, District Gomati, Tripura, India

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ABSTRACT

Indicators help to determine the equivalent point of an acid base titration. Today synthetic indicators are extensively used in the acid-base titrations. But due to environmental impact, availability and cost, the requirement for natural compounds as an acid-base indicator has increase. These natural indicators are found to be a very useful, economical, simple, available and eco-friendly. The present investigation highlights the usefulness of Basella alba fruit extract as natural acid-base indicator in titrations. This natural indicator is easy to extract as well as easily available. Promising results were obtained when it was compared against Phenolphthalein, a popularly used synthetic acid-base indicator. Titrations at different conditions showed sharp color change at the equivalence point. The equivalence points obtained by the fruit extract and standard indicator coincide with each other.

Keywords: *Basella alba*, pigment, acid-base indicator, eco-friendly, end point.

INTRODUCTION

Basella alba is a wildly cultivated cool season vegetable. Fruits of *Basella alba* are fleshy, stalkless, spherical and purple when mature. *Basella alba*, commonly known as Spinach or Malabar spinach belongs to the Myrt Basellaceae family. Fruit extract of *Basella alba* contains pigments- Betacyanin and Flavanoid. The major red pigment present in dye extract is gomphrenin-I, which is the compound of betalain family. Presence of pigments, fruit extract of *Basella alba* can extensively be used as a natural colorant on fabrics [1].

In the present investigation fruits from *Basella alba* plant were used as acid base indicator, to detect the end point of acid base titrations. Synthetic colorants are generally harmful and cause allergies to human beings. Because of environmental and high health hazards in the production and use of synthetic dyes and pigments, the use of natural colorant has been increasing globally. The current studies also dealt with the spectroscopic analysis of the natural dye from the fruit extract in presence of buffer at lower and at higher pH values, whether it can properly be used as the replacement of phenolphthalein or not.

From the physical properties of the extract, it was observed that the pH of the main extracted dye is 4.9 as measured by pH meter [1]. The original color of the dye is violet. But a sharp change of color can be observed with the change in pH values. This indeed be the basic reason as to why the extract of *Basella alba* be successfully used as an indicator for acid-base titrations.

EXPERIMENTAL SECTION

2.1 Materials:

The following materials are used during the investigation:

- Extracted *Basella alba* pigment.
- Phenolphthalein as acid-base indicators.
- Analytical grade reagents i.e. hydrochloric acid (HCl), sodium hydroxide (NaOH), acetic acid (CH_3COOH), ammonium hydroxide (NH_4OH)

[Reagents were collected from Chemistry laboratory of M.B.B College, Agartala, Tripura (W)]

2.2 Sample collection:

Basella alba fruits were collected from adjacent area of M.B.B College, Agartala, West Tripura and stored in sealed polyethylene bags at 4^0C until extraction.

2.3 Extraction of the fruit:

The fruits were cleaned well under tap water. 10gm of fresh fruits of *Basella alba* were extracted with little warmed water for 15 minutes and stored in a air tight container.

2.4 Spectroscopic Analysis of the extracted dye:

2.4.1 Absorption spectra of the fruit extract:

The main extracted dye was used directly to perform the absorbance studies. The extract was kept in dark. Absorbance of the solution was measured at wavelength range from 330-640nm with a UV-VIS spectrometer model LT-29 (wavelength 200-700nm, light used tungsten lamp for visible range 350-700nm).

2.4.2 Spectral behaviour of the dye under different pH range:

The colour of the dye also goes on changing and hence a significant change of the spectra is observed under different pH values. Two different solutions were prepared by adding suitable buffer solution to maintain the pH at 4 and at 9 along with the main extracted dye.

Table-1: Variation of color at different pH values:

Solution prepared	*Colour of the solution*
Water + Dye	Violet
Buffer (pH 4) + Dye	Dark Violet
Buffer (pH 9) + Dye	Pink

The solutions were kept in the dark and protected from light by wrapping the container with black paper. Absorbance of the solutions were measured at wavelength ranging from 350-700nm with a UV-VIS Spectrophotometer (Model LT-29).

2.5 Titration with the Basella alba fruit extract:

1ml of the *Basella alba* fruit extract was added to each titration type as indicator - strong acid v/s strong base, strong acid v/s weak base, weak acid v/s strong base and weak acid v/s weak base and three observations were taken to check the precision. Again the titrations were performed using phenolphthalein indicator as standard and the results obtained were compared with the results of titrations using plant extract indicator.

Table-2a: Titration of HCl solution against NaOH:

Obs. No.	Volume of NaOH solution (ml)	Burette Reading (ml)		
		Initial	Volume of HCl solution using Phenolphthalein	Volume of HCl solution required Basella alba extract
1.	25	0	22	21.9
2.	25	0	22	22
3	25	0	21.9	21.9

Table-2b: Titration of HCl solution against NH_4OH:

Obs. No.	Volume of NH_4OH solution (ml)	Burette Reading (ml)		
		Initial	Volume of HCl solution using Phenolphthalein	Volume of HCl solution using Basella alba extract
1.	25	0	22.5	22.4
2.	25	0	22.4	22.4
3	25	0	21.5	22.3

Table-2c: Titration of CH_3COOH solution against NaOH:

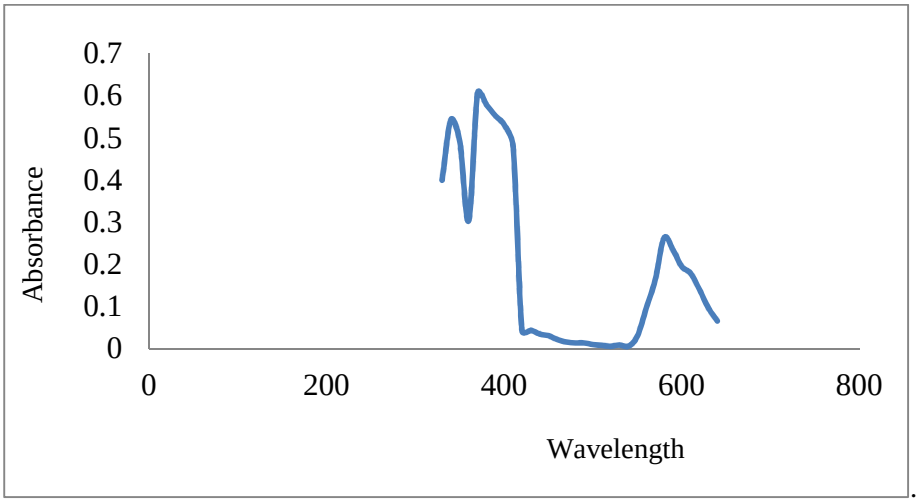
Obs. No.	Volume of NaOH solution (ml)	Burette Reading (ml)		
		Initial	Volume of CH_3COOH solution using Phenolphthalein	Volume of CH_3COOH solution using Basella alba
1.	25	0	21.8	21.7
2.	25	0	21.8	21.8
3	25	0	21.7	21.7

Table-2d: Titration of CH_3COOH solution against NH_4OH:

Obs. No.	Volume of NH_4OH solution (ml)	Burette Reading (ml)		
		Initial	Volume of CH_3COOH solution required using Phenolphthalein	Volume of CH_3COOH solution using Basella alba
1.	25	0	22.6	22.6
2.	25	0	22.7	22.6
3	25	0	21.6	22.5

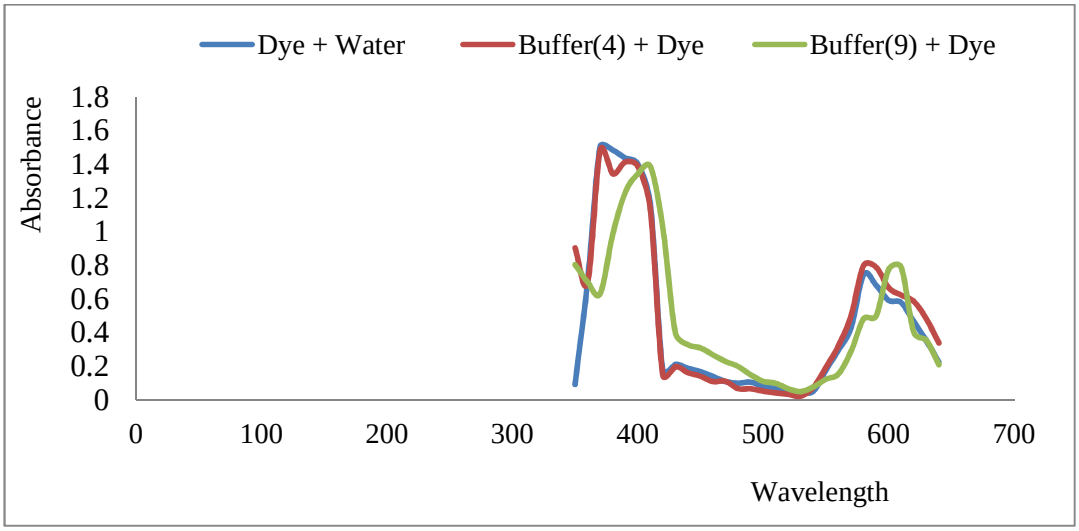
RESULTS AND DISCUSSION

The investigation dealt with the studies on the physical properties of the extract from *Basella alba* as to whether it can be used as an acid-base indicator. From the absorbance v/s wavelength graph (Scheme-1) of the original dye, two prominent peaks at around 340nm and 590nm wavelength are observed of intensities 0.5 and 0.3 respectively, confirming the presence of coloring pigments.



Scheme-1: ***Absorbance v/s Wavelength graph for the original dye extract***

Change of the pH, the colour of the dye goes on changing and hence a significant variation of spectral graph with respect to wavelength and intensities of peaks can be observed. It could be observed from the graph (Scheme-2) that there are significant change in peaks and intensities of the solutions with variation of pH that support the variation of colour of the dye at different pH.



Scheme-2: Absorbance v/s Wavelength graph for dye/buffer interaction

For all the 4 types of titrations equivalence point obtained by aqueous extract of *Basella alba* was found to be nearly closed with equivalence point obtained by standard phenolphthalein. This represents the usefulness of fruit extract as an indicator in acid base titrations.

Table-3: Variation of color of indicators at different conditions:

Titrant	*Titrand*	*Change of color with indicator*	
		Phenolphthalein	*Basella alba extract*
HCl	NaOH	Colorless to pink	Deep violet to deep pink
HCl	NH_4OH	Colorless to pink	Violet to deep pink
CH_3COOH	NaOH	Colorless to pink	Deep violet to light pink
CH_3COOH	NH_4OH	Colorless to pink	Violet to pink

CONCLUSION

The end point or equivalence point of the titrations using the fruit extract either coincided or almost reached close to the equivalence point using phenolphthalein for all the specified titrations. The spectroscopic measurement revealed the presence of two different colors at different pH values. It proved to be more reliable than the standard indicator. It gave sharp change of the color at equivalence point of the titrations. From the study it is clear that *Basella alba* fruit extract can extensively be used as potent acid-base indicator in acid base titrations.

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