International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Impact Factor (2012): 3.358

Beetroot-Herbal Alternative to Synthetic Indicator in Titrimetric Analysis

Dr. Mrs. P. H. Sharma[1], P. V. Powar[2]

[1, 2]Department of Pharmaceutics, Padmashree Dr. D.Y. Patil College of Pharmacy, Akurdi, Pune, Maharashtra, India

Abstract: ***In acid- base titrations, indicators are used to show a sharp color changes at end point which are mostly organic dyes. Due to environmental pollution, availability and cost, the search for natural acid-base indicator was started. In the present study the extract of Beta vulgaris was used to replace the synthetic indicators due to the disadvantage of less availability and high cost of synthetic dye. Extract of Beta vulgaris gives sharp and intense color changes as compared to synthetic indicator. The extracts were evaluated by using strong acid-strong base, strong acid-weak base, weak acid-strong base and weak acid -weak base. In all these titrations the extract was found to be very useful and accurate for indicating the neutralization point. Ethanolic extract of Beta vulgaris was found to be a very useful, economical, simple and accurate for titration. The proposed herbal indicators can be used as a substitute to synthetic indicators.***

Keywords: Indicator, *Beta vulgaris*, Titrations, End point, betaxanthins, Betanin.

1. Introduction

Beta vulgaris or beetroot, also known as the table beet, garden beet, red or golden beet. Beta vulgaris of family Chenopodiaceae, contains bioavailable compounds and micronutrients such as phenolic compounds, carotenoids, betalains, vitamins and minerals[1].

Figure 1 Beta vulgaris Root

Beetroot is a potential source of valuable water-soluble nitrogenous pigments, called betalains, which are composed of two main groups, the red betacyanins and the yellow betaxanthins. The colour of Betanin depends on pH. It is bright bluish-red, becoming blue-violet as the pH increases. Once the pH reaches alkaline levels Betanin degrades by hydrolysis, resulting in a yellow-brown colour [2].

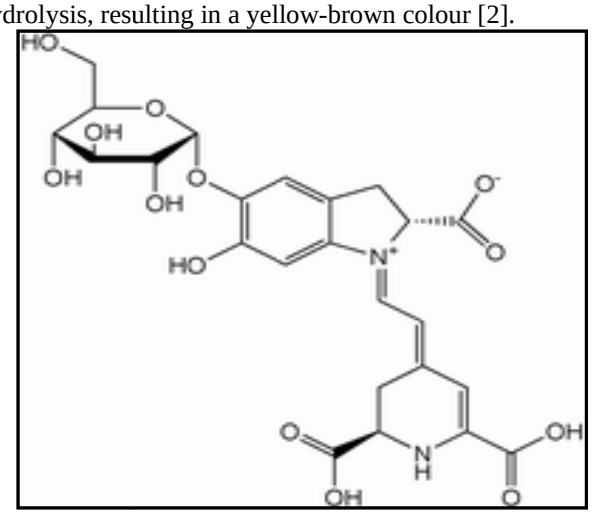


Figure 2: Betanin

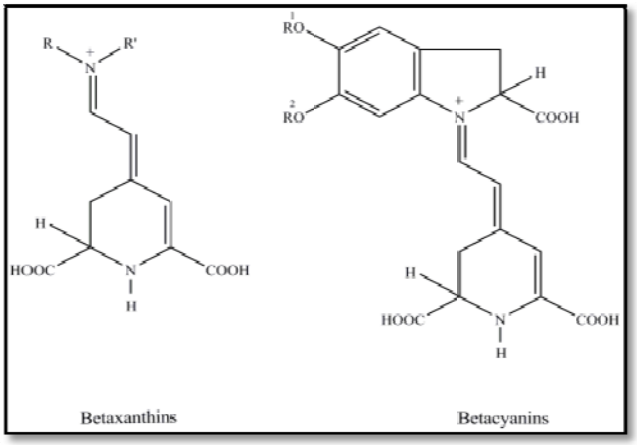


Figure 3: Betaxanthin and Betacynin

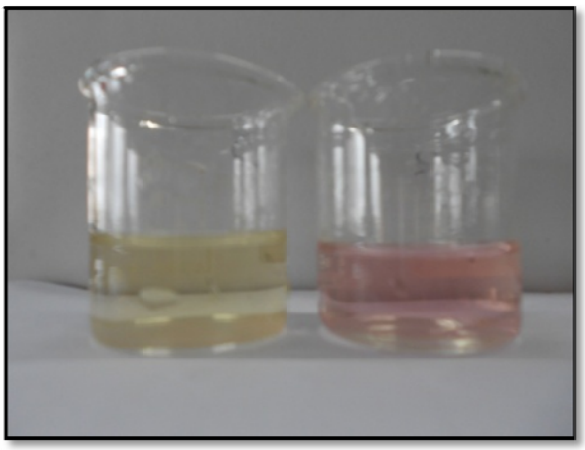


Figure 4: Colour of Betanin in Acidic pH (A) and basic pH (B)

Natural pigments in plants are highly colored substances and may show color changes with variations of pH[3]. But due to environmental pollution, availability and cost, the search for natural compounds as an acid-base indicator was started.

Titrimetric analysis involves the determination of the volume of a solution of known concentration (standard), required to react quantitatively with a solution of the substance to be analysed. An Indicator's colour change

occurs over a range of hydrogen ion concentrations. This range is termed the colour change interval. It is expressed as the Indicator's pH range[4].

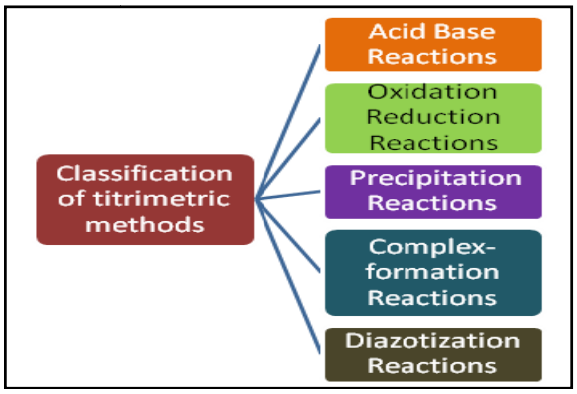


Figure 5: Classification of Titrimetric Methods [5]

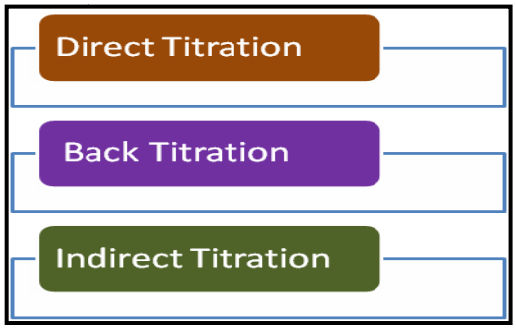


Figure 6: Types of Titration Methods [5]

2. Material and Method

The entire reagent like i.e. Hydrochloric acid (HCL), Sodium Hydroxide (NaOH), Acetic Acid (CH3COOH), Ammonia (NH3), Phenolphthalein, Methyl Red and Methyl Orange were of analytical grade. The fresh fruit were collected from local market and authenticated at National Research Institute of Basic Ayurvedic Sciences, Pune. A voucher specimen was obtained (4407).

2.1Preparation of Indicator

100.0 g of chopped Beetroot was added to 100 ml of solution containing Ethanol- Hydrochloric acid (v/v ratio 99:1) and Ethanol-Water (v/v ratio 1:1) for 45 min, after allowing the beaker to cool for 15 minutes, boiled Beetroot were squashed and the liquid was filtered. The residues were squeezed once again and the liquid has evaporated to get a highly concentrated portion of the indicator. The extract was preserved in tightly closed container and stored away from the direct sun light.

2.2 Acid -Base Titrations

The experiment was carried out by using same set of glassware for all type of titrations. The reagents were not calibrated; as same aliquots were used for both titrations i.e. titrations by using slandered indicator and root extract.5 ml of titrant with 3 drops of indicator was titrated. The experiment was carried in triplicate mean and standard deviation was calculated from results. Same procedure carried for Strong Acid – Strong Base (Hydrochloric acid-Sodium hydroxide), and Weak acid weak base (Acetic acid-Ammonium hydroxide), Strong acid –Weak base (Hydrochloric acid- Ammonium hydroxide) Titrations[5].

3. Result

3.1. Strong Acid – Strong Base Titrations

Table 1: Titration of Strong acid (Hydrochloric acid) with strong base (Sodium Hydroxide) using Synthetic indicator (Phenolphthalein, Methyl red, Methyl orange, Natural indicator like Indicator-1, and Indicator -2)

Titration (titrant vs titrate)	Indicators	Mean	Color change	End point pH
HCl vs NaOH	PH	23.5	Colorless to pink	6
	MR	24.3	Pink to yellow	7
	MO	24	Pink to yellow	7
	Indicator-1	24	Pink to colorless	10
	Indicator -2	22.1	Pink to colorless	10

(PH: Phenolphthalein, MR: Methyl red, MO: Methyl orange, Indicator-1: Ethanol- Hydrochloric acid extract of B. vulgaris, , Indicator-2: Ethanol-Water extract of B. vulgaris)

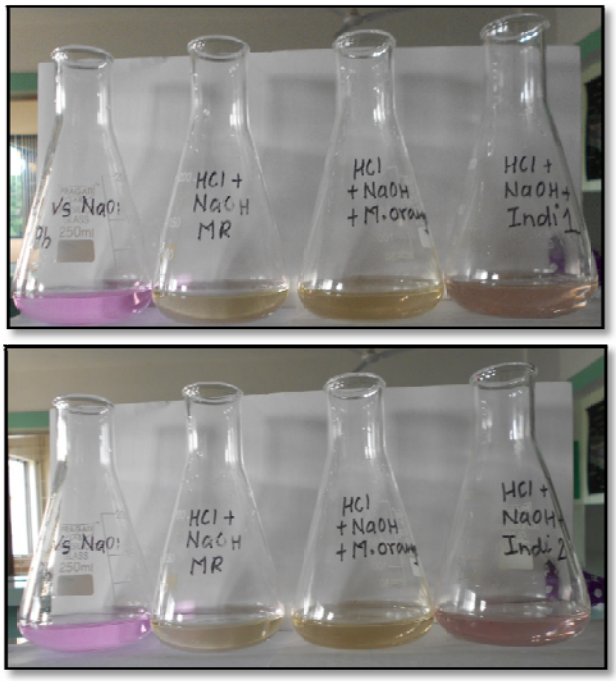


Figure 10 Titration of Strong acid (Hydrochloric acid) with strong base (Sodium Hydroxide) using Synthetic indicator (Phenolphthalein, Methyl red, Methyl orange, Natural indicator like Indicator-1, and Indicator -2)

3.2. Weak Acid – Strong Base Titrations

Table 2: Titration of weak acid (Acetic acid) with strong base (Sodium Hydroxide) using Synthetic indicator (Phenolphthalein, Methyl red, Methyl orange, Natural indicator like Indicator-1, and Indicator -2)

Titration (titrant vs titrate)	Indicators	Mean	Color change	End point pH
CH3COOH VS NaOH	PH	7.1	Colorless to pink	6
	MR	9	Pink to yellow	6
	MO	4.5	Orange to yellow	6
	Indicator-1	9.5	Pink to colorless	10
	Indicator -2	8	Pink to colorless	10

(PH: Phenolphthalein, MR: Methyl red, MO: Methyl orange, Indicator-1: Ethanol- Hydrochloric acid extract of B. vulgaris, , Indicator-2: Ethanol-Water extract of B. vulgaris)

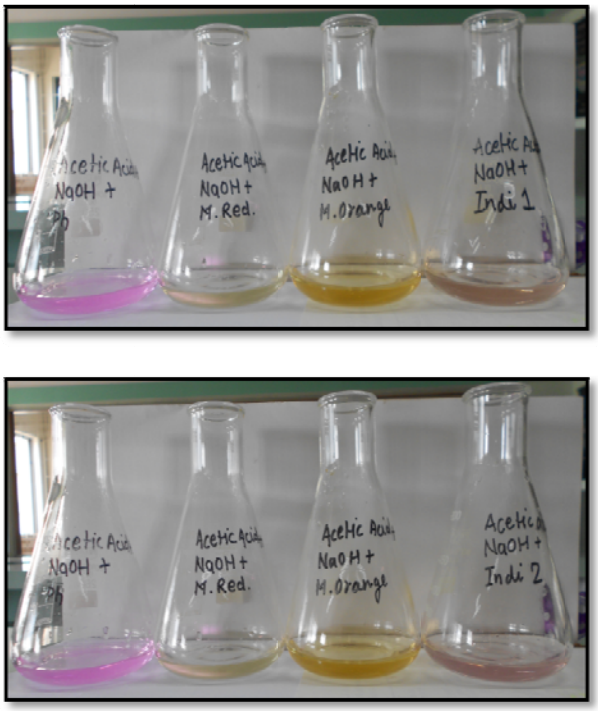


Figure 11: Titration of weak acid (Acetic acid) with strong base (Sodium Hydroxide) using Synthetic indicator (Phenolphthalein, Methyl red, Methyl orange, Natural indicator like Indicator-1, and Indicator -2)

3.3. Weak Acid – Weak Base Titrations

Table 3: Titration of weak acid (Acetic acid)with Weak base(Ammonium Hydroxide) using Synthetic indicator (Phenolphthalein, Methyl red, Methyl orange, Natural indicator like Indicator-1, and Indicator -2)

Titration (titrant vs titrate)	Indicators	Mean	Color change	End point pH
CH3COOH vs NH4OH	PH	19.5	Colorless to pink	9
	MR	11.5	Pink to yellow	6
	MO	9.8	Orange to yellow	6
	Indicator-1	25	Pink to faint pink	10
	Indicator-2	27.5	Pink to faint pink	10

(PH: Phenolphthalein, MR: Methyl red, MO: Methyl orange, Indicator-1: Ethanol- Hydrochloric acid extract of B. vulgaris, Indicator-2: Ethanol-Water extract of B. vulgaris)

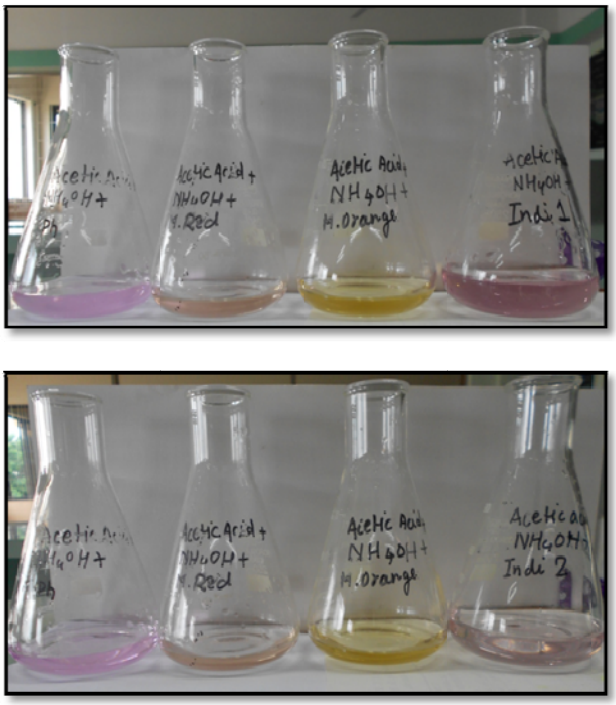


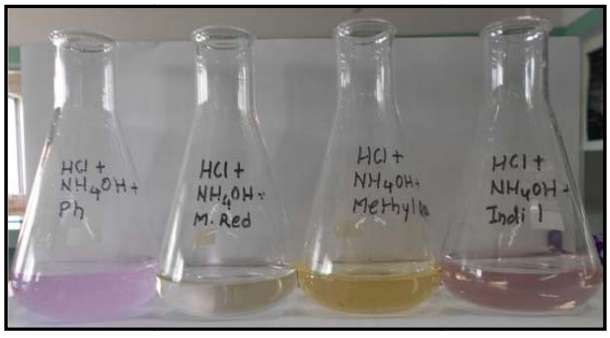
Figure 12: Titration of weak acid (Acetic acid) with Weak base (Ammonium Hydroxide) using Synthetic indicator (Phenolphthalein, Methyl red, Methyl orange, Natural indicator like Indicator-1, and Indicator -2)

3.4. Strong Acid – Weak Base Titrations

Table 4: Titration of Strong Acid (Hydrochloric acid) with Weak base (Ammonium Hydroxide) using Synthetic indicator (Phenolphthalein, Methyl red, Methyl orange, Natural indicator like Indicator-1, and Indicator -2)

Titration (titrant vs titrate)	Indicators	Mean	Color change	End point pH
HCl vs NH4OH	PH	56	Colorless to pink	9
	MR	41.5	Pink to yellow	7
	MO	40.9	Pink to yellow	7
	Indicator-1	55.2	Pink to colorless	10
	Indicator-2	46.2	Pink to colorless	7

(PH: Phenolphthalein, MR: Methyl red, MO: Methyl orange, Indicator-1: Ethanol- Hydrochloric acid extract of B. vulgaris, Indicator-2: Ethanol-Water extract of B. vulgaris)



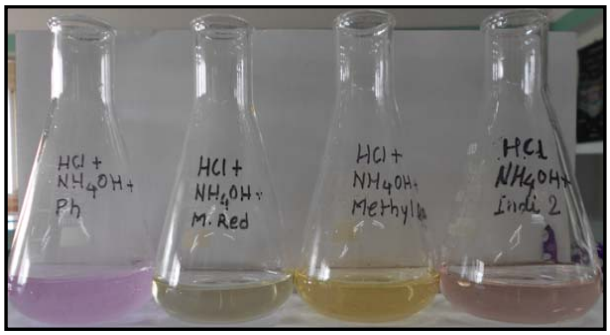


Figure 13: Titration of Strong Acid (Hydrochloric acid) with Weak base (Ammonium Hydroxide) using Synthetic indicator (Phenolphthalein, Methyl red, Methyl orange, Natural indicator like Indicator-1, and Indicator -2)

The beet root extract was screen its used as acid base indicator and result of screening were compared with the result obtained by synthetic indicators like Phenolphthalein, Methyl red, Methyl orange .From the result it represent that the beet root extract useful as indicator in acid –base titration, it's used in acid base titration was found to be more significance over synthetic indicator as it gives sharp colour change in different pH range. This result obtained showed that the routinely used synthetic indicator can be successfully replaced by beet root extract.

4. Conclusion

From the result it was conclude that the synthetic indicators could be replaced by Beet root extract as they are simple accurate economical and précised and can be prepared just before the experiment. The proposed natural indicator can be used as a substitution to synthetic indicator. We can also concluded that it is always beneficial to used beet root extract as an indicator in all types of acid base titration because of its economics, simplicity and wide availability.

5. Future Scope

The stability of Natural indicator and its application to the various fields such as textile industry, leather industry, food industry and chemical industry. These are future scope of the present study

References

[1] M.S. Rabasovica, D. Sevica;, M. Terzicb, S. Savic-Sevica, B. Murica, D. Pantelica and B.P. Marinkovica(2009),"Measurement of Beet Root Extract Fluorescence Using TR-LIF Technique", Acta Physica Polonica, Vol.No 116, Issue 4, pp 570-572.
[2] Henriette M.C.Azeredo.(2009),"Betalains: properties sources applications, and stability-a review" , International Journal of Food Science and Technology, Vol.No 44, Issue 1,pp 2365-2376.
[3] Agrawal S, Raj N. R., Chouhan, K,.Raj C N, Jain S., Balasubramaniam A. (2011),"Isolation of herbal acid-base indicator from the seeds of Punica granatum", Journal of Chemical and Pharmaceutical Research, Vol.No.3,Issue 2,pp 168-171.
[4] Kasture.A.V, Wadodar S.G., Gokhale S.B., (1995),Practical Pharmaceutical chemistry-I, Nirali Prakashan,Second edition,36-38.
[5] Kasture.A.V, Wadodar S.G., Mahadik K.R., & More H.N.(2008). Pharmaceutical Analysis-I, Nirali Prakashan, Vol.1,Thirteen Edition,6.1-6.20

Author Profile

Dr. (Mrs) Padmini H.Sharma received the B. Pharm., M. Pharm and PhD. Degree in Pharmaceutical science from Rashtrasant Tukdoji Maharaj Nagpur University in 2002, 2005 and 2012 respectively. She has 14 research papers in international and national repute journal. She is member of different professional bodies such as Association of Pharmaceutical Teachers of India, Inpharm Association, Research Scholar Hub and Pharma Research Library. She is reviewer of journal of pharmaceutical chemistry .Her research area are novel drug delivery system. Herbal medicine and microbiology. Currently working as Associate Professor at Dr.D.Y.Patil College of Pharmacy Pune, India.