International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 6 Nov - Dec 2025, pp: 63-66 www.ijprajournal.com ISSN: 2456-4494

Plant sources as Natural Indicators in Acid-base titrations

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Date of Submission: 01-11-2025 Date of Acceptance: 10-11-2025

ABSTRACT
The toxic nature of synthetic dyes poses an urgency for an alternative. Plant sources are cheap and non-toxic counterparts to synthetic ones.Among the selected plant sources, extracts of turmeric, orange peel and onion peel display a close agreement with that of the standard indicator phenolphthalein for strong acid-strong base titrations. Chrysanthemum flower extract proves to be a suitable indicator against the methyl orange indicator. Again, chrysanthemum flower andorange peel extracts can be an alternative for weak acid-strong base titrations.The selected natural sources show a sharp colour transition.

Keywords: Plants, Indicators, Acid-base titration, Eco-friendly, Sustainable.

I. INTRODUCTION

Natural indicators are an eco-friendly and safe alternative to their synthetic counterparts.Equivalence points can be analysed easily using such indicators, as they impart sharp colour transitions [1-6].

All the plant parts, leaves, roots, andflowers can be used as indicators from the selected species. Plant parts display antibacterial, antiviral and antifungal properties.Moreover, plant sources possess antioxidant activity also, which helps us against reactive oxygen species as well as the other free radical species [7-9].

Indicator properties of plant sources are due to the presence of dye compounds such as anthocyanin, carotenoids, anthraquinones and tannins [10]. The dye compounds display sharp colour transition with respect to the pH change, apart from possessing antimicrobial and antioxidant nature. Sources that impart a sharp colour change within the equivalence point can be considered as a good indicator.

The present study focuses on extracts from chrysanthemum flowers, orange peel, onion peel, turmeric, carrots and rose petalsfor their usage as natural indicatorsin acid-base titrationsagainst the standard synthetic counterparts such as phenolphthalein and methyl orange.

II. MATERIALS AND METHODS

Chemicals used: Hydrochloric acid, oxalic acid, sodium carbonate, sodium hydroxide used here are of AR grade.

Preparation of natural extracts:

Extracts from chrysanthemum flowers, orange peel, onion peel, turmeric, carrots and rose petals were filtered out by boiling the respective sources with a minimum amount of water.

Acid-base titrations:

For strong acid-strong base titration, hydrochloric acid (0.01N) and sodium hydroxide (0.01N) were titrated using phenolphthalein as a standard indicator. The same titration was repeated using natural indicator extracts.

Similarly, using phenolphthalein as a standard indicator, oxalic acid (0.01N) was titrated against sodium hydroxide (0.01N). The titration was performed using natural indicators also.

Hydrochloric acid (0.01N) and sodium carbonate (0.01N) were titrated using methyl orange as a standard indicator. The titration was conducted using natural indicators also.

III. RESULTS AND DISCUSSION

The selected plant sources effect a sharp colour change with respect to the change in pH (Table 1).Equivalence points for the respective acid-base titrations were tabulated against standard synthetic indicators.

For strong acid-strong base titration, turmeric, orange peel and onion peel extracts show a close agreement with that of the standard.Turmeric extracteffects a change in colour fromorange to yellow, whereas orange and onion peel extract displays a colour transition from yellow to colourless.Other natural indicators impart a value lower or higher than the standard value (Table 2).

Chrysanthemum flower extract proves to be a suitable indicator for titration between hydrochloric acid and sodium carbonate. A sharp colour transition from green to colourlesssignifies the equivalence point (Table 3).

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Again, for titration between oxalic acid and sodium hydroxide,chrysanthemum flower and orange peel extracts are found to have a close resemblance to that of the standard one. The end point is indicated by a change in colour from green to colourless for both the extracts (Table 4). The change in molecular structure with respect to medium change effects the colour transition.But with decrease in the strength of weak acid and weak base, the sharpness of colour change was also decreased [11].

All the above natural extracts are reported to be a promising source for antioxidant and antimicrobial activity, proving to be a safer and eco-friendly alternative. Orange peel possesses carotenoids and phenolic compounds [12]whereas onion peel containsquercetin andanthocyanidin compounds [13], turmeric contains curcuminoid compounds [14]and chrysanthemum flower is packed with anthocyanin and carotenoids [15].

Though synthetic indicators yield precise and efficient results, they areexpensive and harmful to the environment. Phenolphthalein, which is a commonly used chemical indicator, causes ovarian cancer andmethyl orange causes lung damage, eye irritation, skin destruction and dermatitis. Some are even unstable and degraded over time [16].

Table1: Colour change in indicators with respect to medium

Source	Acidic medium	Basic medium
Turmeric	Light orange.	Reddish orange
Carrot	Light orange	Light yellow
Chrysanthemum	Pink	Yellowgreen
Onion peel	Red	Yellow
Orange peel	Light brown	Yellow
Rose petal	Red	Golden yellow

Table 2: Titration between hydrochloric acid and sodium hydroxide

Indicator	Volume of HCl consumed (ml)	Colour change
Phenolphthalein	14.8	Pink to colourless
Turmeric	15.0	Orange to yellow
Carrot	8.5	Yellow to Colourless
Chrysanthemum	15.6	Green to colourless
Onion peel	15.2	Yellow to colourless
Orange peel	14.6	Yellow to colourless
Rose petals	15.7	Yellow to colourless

Table 3: Titration between hydrochloric acid and Sodium carbonate

Indicator	Volume of HCl consumed (ml)	Colour change
Methyl orange	18.3	Yellow to red
Turmeric	7.6	Orange to yellow
Carrot	11.5	Orange to colourless
Chrysanthemum	18.6	Green to colourless
Onion peel	10.1	Green to colourless
Orange peel	12.9	Green to colourless
Rose petals	12.5	Green to colourless

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Table 4: Titration between oxalic acid and Sodium hydroxide

Indicator	Volume of oxalic acid consumed (ml)	Colour change
Phenolphthalein	14.5	Pink to colourless
Turmeric	16.4	Orange to yellow
Carrot	20.0	Orange to colourless
Chrysanthemum	15.0	Green to colourless
Onion peel	11.2	Yellow to colourless
Orange peel	14.9	Green to colourless
Rose petals	17.3	Yellow to colourless

Temperature, light, pH, and the presence of metal ions can influence the stability of natural dyes.Anthocyanin can undergo photo as well as thermal degradation, whereas metal ions can lead to the formation of complexes that affect their stability and bioavailability. Heating and extraction procedures can result in a change of chemical structure [17,18]. Carotenoids are reported to be highly sensitive to light [19]. Apart from its stability which should be overlooked in future studies, natural indicators are non-toxic, readily available and environment friendly.

IV. CONCLUSION

Natural extracts are safer, eco-friendly and cost-effective substitutes for their synthetic counterparts. Among the selected natural sources, orange peel, onion peel, turmeric and chrysanthemum flower extracts are proved to have a good indicator action with a prominent and clear colour transition at theirequivalence point.Despite their limited shelf life, natural indicators can become a valuable and sustainable alternative.

REFERENCES

[1]. Okoduwa SI, Mbora LO, Adu ME, Adeyi AA. Comparative Analysis of the Properties of Acid-Base Indicator of Rose (Rosa setigera), Allamanda (Allamanda cathartica), and Hibiscus (Hibiscus rosa-sinensis) Flowers. Biochip Res Int. 2015;2015:381721.

[2]. Sashikala S, et al. Eco-Friendly Natural Flowers as Indicators in Acid-Base Titrations. J. Chem Pharm. Res. 2023; 15(5):043.

[3]. Balasaheb KR, et al. Formulation of natural indicators from Hibiscus rosa sinensis, Allium cepa, Beta vulgaris and Curcuma longa. Research journal of Pharmacognosy and Phytochemistry. 2025; 17(3): 205-208.

[4]. Dara SR. An Overview of the Use of Natural Indicators in Acid-Base Titrations. UPI Journal of Pharmaceutical, Medical and Health Sciences. 2024; 7(1):29-35.

[5]. Chakraborty DD, Paul C, Ghosh A, Chakraborty P. Natural Indicator as a substitute to Synthetic indicator-A Developmental Approach. J App Pharm Sci. 2014; 4(09):120-122.

[6]. Hazra A.Natural Indicator: To Measure the Acid-Base Degree of a Substance. Chem Sci Rev Lett. 2014; 3(12):876-880.

[7]. Ravindra KB, Dinesh YN, Chandrasekhara SM. Antimicrobial Properties of Some Natural Dyes - A Review. Trends Textile Eng Fashion Technol. 2024;10(3):000736.

[8]. Singh R, Jain A, Panwar S, Gupta D, Khare S. Antimicrobial activity of some natural dyes. Dyes and Pigments. 2005;66(2):99-102.

[9]. Brudzyńska P, Kurzawa M, Sionkowska A, Grisel M. Antioxidant Activity of Plant-Derived Colorants for Potential Cosmetic Application. Cosmetics. 2022;9(4):81.

[10]. Biswas S,et al. A Review on Application of Natural Indicators in Acid-base Titration. Pharmacognosy Reviews. 2023; 17:308-319.

[11]. Chavan H,Shirodkar P, Dhake AS, Jadhav AG. Natural indicators as alternative to synthetic acid base indicators. IAJPS. 2017; 4(11):4078-4082.

[12]. Viñas-Ospino A, et al. Comparison of green solvents for the revalorization of

orange by-products: Carotenoid extraction and in vitro antioxidant activity. Food Chemistry.2024; 442:138530.
[13]. Gorrepati K, et al. Characterization and evaluation of antioxidant potential of onion peel extract of eight differentially pigmented short-day onion (Allium cepa L.) varieties. Frontiers in Sustainable Food Systems. 2024; 8-2024.
[14]. Sun J, Zhang Y, Zhang Y, Zhao H, Han G, Via BK, Jiang W. Determination of natural turmeric dyes using near-infrared spectroscopy. Industrial Crops and Products. 2024; 222(3):19817.
[15]. Park CH, Chae SC, Park S-Y, Kim JK, Kim YJ, Chung SO, Arasu MV, Al-Dhabi NA, Park SU. Anthocyanin and Carotenoid Contents in Different Cultivars of Chrysanthemum (Dendranthema grandiflorum Ramat.) Flower. Molecules. 2015; 20(6):11090-11102.
[16]. Maqsood W, et al.Efficacy of plant extracts as green indicators in acid-base titrimetric analysis: Perspective towards green chemistry.Microchemical Journal.2025; 213:113613.
[17]. Verma D, Sharma N, Malhotra U. Structural chemistry and stability of anthocyanins. The Pharma Innovation Journal. 2023; 12(7):1366-1373.
[18]. Laleh GH, Frydoonfar H, Heidary R. The effect of light, temperature, pH and species on stability of anthocyanin pigments in four Berberis species. Pak J Nutr. 2006; 1:90-92.
[19]. Singh SS. Natural Dyes: Chemistry, Applications, and Sustainability.The Academic.2025; 3(1):256-267.