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RESEARCH ARTICLE

Use of *Bixa orellana* Fruit Extract as a Natural Indicator in Acid Base Titration

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ABSTRACT

A change in color with variation in pH is due to presence of colored plant pigments therefore they are used in acid base titration to show sharp end point. Present study suggested the use of bixa orellana fruit extract as a natural indicator for acid base titration. Color intensity of ethanolic extract of *Bixa orellana* (L) from family *Bixaceae* was compared with methyl red and this indicator are evaluated by Strong acid-Strong base, Strong acid-Weak base, Weak acid-Strong base, Weak acid-Weak base. In all this titration the extract was found to be very useful for indicating neutralization point. The authors suggested that the use of natural indicator is a cheap as it is easily available, simple to extract, environmentally and user friendly and found to be excellent substituent for standard indictors.

KEYWORDS

Bixa Orellana, Ethanolic Extract, Acid-Base Titration, Natural Indicator, End Point

INTRODUCTION

In Aqueous acid base titrations H_3O in solution is titrated by OH^- ions and this can be applied regardless of whether strong acids, strong bases, weak acids, weak bases, salts of weak acid, salt of weak base are in titration reaction, e.g.

$$HCl + NaOH \rightleftharpoons NaCl + H_2O$$

$$CH_3COOH + NaOH \rightleftharpoons CH_3COONa + H_2O$$

$$HCl + NH_4OH \rightleftharpoons NH_4Cl + H_2O$$

$$CH_3COOH + NH_4OH \rightleftharpoons CH3COONH_4 + H_2O$$

The point at which complete neutralization is achieved is the end point of titration. Indicators are the chemical substances whose solutions change color due to changes in the power of hydrogen (pH) and used for detection of end Point.[1] Indicators are dyes or pigments that can be isolated from a variety of sources, including plants, fungi, and algae. Almost any flower, for example, that is red, blue, or purple in color contains a class of organic pigments called anthocyanin's that change color with pH. The use of natural dyes as acid-base indicators was first reported in 1664 by Sir Robert Boyle in his collection of essays Experimental History of Colors.[9] The advantage of natural indicators is that they are biodegradable thus helps in minimizing the use of synthetic non degradable dyes. Hence in this work, we described the used of fruit extract of *Bixa orellana* as an indicator for titration.[8] Earlier studies done on the synthetic indicators like phenolphthalein, methyl orange helped to identify their toxic and hazardous effects. Moreover, they also possess disadvantages like availability problems and high cost. The study was done with an aim of finding a suitable substitute to replace the synthetic indicators and to bring in the practice of using the fruit extract as indicators in

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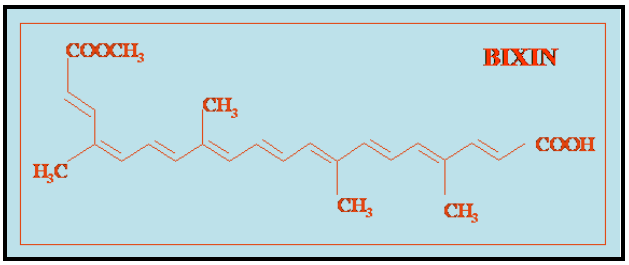
neutralization titrations.[7] *Bixa orellana* is an evergreen shrub or small tree, 2-8 m high; trunk up to 10 cm in diameter; bark light to dark brown, tough, smooth, sometimes fissured, lenticellate; inner bark pinkish towards the outside with orange sap, slightly bitter; twigs green with minute, rusty, reddish-brown scales, becoming dark brown. Fruit a spherical or broadly elongated ovoid capsule, 2-4 x 2-3.5 cm, flattened, 2 valved, more or less densely cloaked with long bristles, green, greenish-brown or red when mature; seeds numerous, obovoid and angular, 4.5 mm long, with bright orange-red fleshy coats. *Bixa orellana* requires a frost-free, warm, humid climate and a sunny location. It can grow in tropical to subtropical climates where rainfall is distributed throughout the year.[6]

Fruits

Split seed pod

Bixa plants are commercially grown for the high apocarotenoid pigment content "annatto" in its seed coat. Annatto, a mixture of eight colourants of carotenoid group can act as a pigment in a number of different chemical forms; the predominant form being bixin (>80% of the total carotenoid content) and also comprises of norbixin, β-carotene, cryptoxanthin, lutein, zeaxanthin and methylbixin.[10]



MATERIALS AND METHOD

Fresh fruits of *Bixa orellana* were collected from medicinal plant garden of GES's Satara College of Pharmacy, Degaon, Satara and authenticated at the Department of Pharmacognosy SCOP, Satara. Analytical grade reagents like hydrochloric acid (HCl), sodium hydroxide (NaOH), Acetic Acid (CH_3COOH), ammonia (NH_3) and methyl red were procured from Satara College of Pharmacy, Degaon, Satara. The authors convey their sincere thanks to Satara College of Pharmacy, Satara for providing materials and equipments for conducting experimental work. The authors are also very greatful to Mr.H.L.Tare (Asst. Prof. of Pharmacognosy Dept.) for authentification of plant sample.

Collection of fruits

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Authentication of plant

↓

Isolation of seeds

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Extraction of fruits

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Acid base titration

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Compared with standard indicator (Methyl Red)[5]

RESULTS AND DISCUSSION

For all types of titrations equivalence point obtained by ethanolic extract of *Bixa orellana* was found to be nearly closed with equivalence point obtained by standard indicator methyl red. This represents the usefulness of alcoholic fruit extract as an indicator in acid-base titration.[4]

Table 1: Technological characterization for analysis and comparisons of color change[2, 3]

Titrant	Titrate	Standard (pH range)	Indicator color change (pH range)
HCl	NaOH	Yellow to Red (9-4)	Yellow to yellowish Brown(8-5)
HCl	NH_4OH	Yellow to Red(9-4)	Yellow to yellowish Brown(8-5)
CH_3COOH	NaOH	Yellow to Red(9-4)	Yellow to yellowish Brown(8-5)
CH_3COOH	NH_4OH	Yellow to Red(9-4)	Yellow to yellowish Brown(8-5)

Table 2: Parameters used for experiment and the results of screening of *Bixa orellana*

Titration (titrant v/s titrate)	Strength (M)	Indicator	Mean of three titration ± S.D
HCl v/s NaOH	0.1	Methyl red Fruit extract	11.66±0..057
			12.53±0.23
	0.5	Methyl red Fruit extract	11.16±0.057
			10.53±0.17
	1	Methyl red Fruit extract	12.03±0.057
			11.46±0.152
	5	Methyl red Fruit extract	12.03±0.057
			11.46±0.057

Table 3: Parameters used for experiment and the results of screening of *Bixa orellana*

Titration (titrant v/s titrate)	Strength (M)	Indicator	Mean of three titration ± S.D
HCl v/s NaOH	0.1	Methyl red Fruit extract	9.06±0.057
			8.46±0.115
	0.5	Methyl red Fruit extract	10.06±0.057
			10.56±0.11
	1	Methyl red Fruit extract	17.03±0.057
			16.83±0.057
	5	Methyl red Fruit extract	19.73±0.057
			20.43±0.057

Table 4: Parameters used for experiment and the results of screening of *Bixa orellana*

Titration (titrant v/s titrate)	Strength (M)	Indicator	Mean of three titration ± S.D
HCl v/s NaOH	0.1	Methyl red Fruit extract	9.3±
			10.06±0.11
	0.5	Methyl red Fruit extract	10.16±0.288
			9.03±0.057
	1	Methyl red Fruit extract	11.03±0.057
			11.06±0.11
	5	Methyl red Fruit extract	10.56±0.057
			11.13±0.057

Table 5: Parameters used for experiment and the results of screening of *Bixa orellana*

Titration (titrant v/s titrate)	Strength (M)	Indicator	Mean of three titration ± S.D
HCl v/s NaOH	0.1	Methyl red Fruit extract	8.1±0.1
			9.16±0.28
	0.5	Methyl red Fruit extract	11.6±0.11
			10.76±0.23
	1	Methyl red Fruit extract	10.06±0.11
			17.26±0.28
	5	Methyl red Fruit extract	16.26±0.057
			16.46±0.057

CONCLUSION

From results obtained in all types of acid-base titrations lead us to conclude that, the synthetic indicators could be replaced successfully by fruit extract. As they are easily available, cheap, accurate and precise and can be prepared just before the experiment by simple maceration process.

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