Research Article

Use of *Mirabilis jalapa* L flower extract as a natural indicator in acid base titration

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ABSTRACT

Mirabilis jalapa L commonly known as four o'clock flower is belonging to family Nyctaginaceae. The present work highlights the use of *Mirabilis jalapa* L flower extract as an acid base indicator in different types of acid base titrations. The equivalence points obtained by the flower extract coincide with the equivalence points obtained by standard indicators. In case of weak acid and weak base titration, the results obtained by the flower extract matched with the results obtained by mixed indicator. This natural indicator is found to be a very useful, economical, simple and accurate for the said titration.

Key words: *Mirabilis jalapa* L, Acid base indicator, Natural indicator, Flavonoids.

INTRODUCTION

Mirabilis jalapa L family Nyctaginaceae is commonly known as four o'clock flower or clavillia. It is a quick growing much-branched perennial herb with erect, angular, distinctly joined stem, swollen at the nodes. Leaves deep green, ovate and flowers in-group of three flowers with five green bracteoles, surrounding the perianth, usually yellow, crimson, white or variegated and opening in the evening. Perianth lobes five, gamophyllus, stamens five with unequal filaments. Carpel one, unilocular, superior ovary with a single base ovule, a nectariferous disc surrounds the ovary. Fruit achene surrounded by a leathery, ribbed, persistent perianth[1-4].

Chemical analysis of clavillia showed that, it is rich in many active compounds including triterpenes, proteins, flavonoids, alkaloids, and steroids[5]. Clavillia's main chemicals include alanine, alpha-amyrins, arabinose, beta amyrins, betalamic acid, betanin, brassicasterol, beta-sitosterols, 2-carbosyarabinitol, campesterol, daucosterol, d-glucan, dopamine, hexacosan-1-ol, indicaxanthin, isobetanin, 6-methoxyboeravinone C, methylabronisoflavone, mirabilis antiviral proteins, mirabilis peptides, miraxanthins, n-dotriacontane, n-hentriacontane, n-heptacosane, n-hexacosane, n-nonacosane, n-octacosane, n-pentacosane, n-pentatriacontane, n-tetracosane, n-tetratriacontane, n-triacontane, n-tricosane, n-tritriacontane, oleanolic acid, stigmasterol, tartaric acid, trigonelline, tryptophan, ursolic acid, and vulgaxanthin I[6]. Four O'clock flowers mainly consist of flavonoids, anthocyanins[7]. The whole plant is used for its antiviral, antibacterial, anticandidal, antifungal, antispasmodic actions. The root is having aphrodisiac, diuretic and purgative properties. It is also used in the treatment of dropsy[8-9].

In the seventeenth century chemist Robert Boyle, described indicators extracted from roses and other plant materials in his book "The Experimental History of Colors" published in 1664[10]. Boyle included the ability to turn plant juices red among the properties of acids. The possibilities listed were only a few of many. Almost any highly colored fruit or vegetable or flower petal has the potential for use as an acid base indicator. Acid-base indicators are commonly

employed to mark the end of an acid-base titration or to measure the existing P^H of a solution. These are substances that reveal, through characteristic color changes, the degree of acidity or basicity of solutions. Indicators are weak organic acids or bases that exist in more than one structural form (tautomers) of which at least one form is colored. Intense color is desirable so that very little indicator is needed; the indicator itself will thus not affect the acidity of the solution. Care must be used to compare colors only within the indicator range. The indicator range is the P^H interval of color change of the indicator. Some are most common indicators used for beginning chemistry, because its color change is very obvious which makes it easy to use.

A P^H indicator is a halochromic chemical compound that is added in small amounts to a solution so that the P^H (acidity or alkalinity) of the solution can be determined easily.

Hence a P^H indicator is a chemical detector for hydronium ions ($H3O^+$) or Hydrogen ions (H^+) in the Arrhenius model). Normally, the indicator causes the color of the solution to change depending on the P^H [11].

In this study we observed the reaction of flower extract in different P^H conditions and compared natural indicator to commercial indicators with measurement of P^H.

As coloring matter flavonoids, anthocyanins are present in flowers of *Mirabilis jalapa* and are P^H sensitive[12]; it was hypothesized that, this flower extract could be utilized as an indicator for different types of acid base titrations.

MATERIALS AND METHODS:

Analytical grade reagents were made available by Institute of Science, Satara. Reagents and volumetric solutions were prepared as per standard books[13, 14]. *Mirabilis jalapa* flowers were collected from plants growing wild in the hilly region of Satara and authenticated from Department of Botany Yashwantrao Chavan Institute of Science, Satara.

The selected flowers were collected. The fresh petals of these selected flowers were cut into small pieces and were freeze dried by utilizing –20°C temperature to minimize oxidative loss before grinding into fine powder with a mechanical blender[9]. The resulting powder was extracted with methanolic hydrochloric acid, to convert the anthocyanins into their corresponding soluble chlorides. From this solution, anthocyanins were isolated by using ether. Finally extract was filtered and used as indicator. The anthocyanins isolated by this method were confirmed by using various characteristic tests[15].

The experiment was carried by using the same set of glasswares for all types of titrations. As the same aliquots were used for both titrations i.e. titrations by using standard indicators and flower extract, the reagents were not calibrated.

Table 1: Parameters Used For Analysis and the Comparison of Color Change

Titrand	Titrant	Indicator Color Change	
		Standard(P^H range)	**Flowers Extract(P^H range)**
HCl	NaOH	Red to Yellow(3.5 - 8.5)	Green to Colorless(4 - 8)
HCl	NH_4OH	Colorless to Pink(3.5 - 8)	Green to Colorless(4 - 8)
CH_3COOH	NaOH	Colorless to Pink(5 - 9)	Green to Colorless(5 - 9)
CH_3COOH	NH_4OH	Orange to Blue-green(4 - 7.5)	Green to Colorless(4 - 8)

HCl: - Hydrochloric Acid, **NaOH**: - Sodium Hydroxide, **NH_4OH**: - Ammonium Hydroxide.
CH_3COOH: - Acetic Acid.

The equimolar titrations were performed using 10 ml of titrant with three drops of indicator. All the parameters for experiment are given in Table 1. A set of five experiments each for all the types of acid base titrations were carried out. The mean and standard deviation for each type of acid base titrations were calculated from results obtained.

RESULTS AND DISCUSSION:

The flower extract was screened for its use as an acid base indicator in various acid base titrations, and the results of this screening were compared with the results obtained by standard indicators methyl red, phenolphthalein and mixed indicator [methyl orange: bromocresol green (0.1:0.2)[11].

The titrations of strong acid with strong base (HCl & NaOH), strong acid with weak base (HCl & NH_4OH), weak acid with strong base (CH_3COOH & NaOH), and weak acid with weak base (CH3COOH and NH4OH) were carried out using standard indicators and floral extract. The results of these titrations are given in Table 2. The floral extract of *Mirabilis jalapa* was found to have coloring matter flavonoids, anthocyanins and these are P^H sensitive. It could

Table 2: Results of Various Acid Base Indicators.

Sr.No.	Titration(Titrant v/s Titrand)	Strength in Moles	Indicator	Readings with S.D. (+/-)
1	NaOH V/S HCl	0.1	Methyl red	11.2 +/- 0.13
			Flower extract	11.2 +/- 0.19
		0.5	Methyl red	10.8 +/- 0.13
			Flower extract	12.4 +/- 0.16
		1	Methyl red	10.7 +/- 0.15
			Flower extract	10.8 +/- 0.08
2	HCl V/S NH_4OH	0.1	Phenolphthalein	5.1 +/- 0.16
			Flower extract	5.3 +/- 0.25
		0.5	Phenolphthalein	5.2 +/- 0.15
			Flower extract	5.1 +/- 0.17
		1	Phenolphthalein	5.3 +/- 0.08
			Flower extract	5.2 +/- 0.09
3	CH_3COOH V/S NaOH	0.1	Methyl red	10.5 +/- 0.05
			Flower extract	10.8 +/- 0.22
		0.5	Methyl red	10.5 +/- 0.13
			Flower extract	10.7 +/- 0.18
		1	Methyl red	10.2 +/- 0.12
			Flower extract	10.3 +/- 0.13
4	CH_3COOH V/S NH_4OH	0.1	Mixed indicator	4.5 +/- 0.23
			Flower extract	4.6 +/- 0.27
		0.5	Mixed indicator	4.4 +/- 0.20
			Flower extract	4.5 +/- 0.28
		1	Mixed indicator	4.4 +/- 0.12
			Flower extract	4.4 +/- 0.19

HCl: - Hydrochloric Acid, **NaOH**: - Sodium Hydroxide, **NH_4OH**: - Ammonium Hydroxide.
CH_3COOH: - Acetic Acid, **S.D**.: - Standard Deviation.

be due to these flavonoids the sharp end point appeared in the above mentioned titrimetric analyses. The results of P^H changes in various acid base titrations of this floral indicator are shown in Table 1. When the end point determination of acid base titrations by the traditional indicators compared with floral indicator, it was observed that traditional indicators gave incorrect results due to addition of excess of titrant (base) after the neutralization reaction was completed, but floral indicator has given sharp end point because solutions became colorless at the equivalence points. If titrant (base) was added in more amount solution became greenish yellow colored. Thus natural indicator employed in the acid base titrations was found economic, safe and an efficient alternative for traditional indicators. In comparison to this, chemical indicators were found more expensive and hazardous, which proves that floral extract of *Mirabilis jalapa*, as a natural indicator is more worthy.

CONCLUSION:

The results obtained in all the types of acid base titrations lead us to conclude that it was due to the presence of flavonoids, sharp color changes occurred at the end point

of the titrations. We can also conclude that it is always beneficial to use *Mirabilis jalapa* flower extract as an indicator in all types of acid base titrations because of its economy, simplicity and availability.

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