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Study to Find Out Suitability of Water Extract of *Catharanthus Roseus* Flowers as Indicator for Acid-Base Titrations

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Abstract

A laboratory experiment was conducted to find out the suitability of water extract of *Catharanthus roseus* flowers as indicator in different acid-base titrations *viz* strong acid v/s strong base (0.01, 0.1 and 1M HCl with same concentration of NaOH); weak acid v/s strong base (0.1M CH_3COOH with 0.1M NaOH); and weak base v/s strong acid (0.1M NH_4OH with 0.1M HCl). The water extract was obtained by simple boiling of 10%w/v solution of *Catharanthus roseus* flowers in distilled water. The color change of water extract of flower at different pH values was find out pH metrically and for standardization it was compared with phenolphthalein (1% w/v in ethanol) and methyl orange (1% w/v in ethanol) for the same system. The theoretical values of pH at various stages were compared with pH change of natural indicator in this range. Results reveal that the water extract of *Catharanthus roseus* flowers shows the color change at the equivalence point for $HCl \rightarrow NaOH$ and $NH_4OH \rightarrow HCl$ titration but it failed to produce color change at equivalence point for $CH_3COOH \rightarrow NaOH$ titration.

Key words: Analytical chemistry, pH indicators, natural products, neutralization indicator

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Introduction

Titration is one of the most important analytical techniques to find out the concentration of compound present in test solution based on its chemical reaction with suitable acid/alkali[1]. The end point is judged on the basis of color change. This color change occurs due to the activity of specific indicator. Mostly used indicators, in titrimetric analysis, are produced industrially using a number of chemicals which are harmful to human health[2] and environment also. Growing concern of environmental toxicity compel us to find out other eco-friendly sources of indicators[3,4]. Natural plants have beautiful colored flowers whose extract can be used successfully as indicator[5-7]. In present study extract of *Catharanthus roseus* flower have been used as an acid-base indicator. *Catharanthus roseus*, Rose Periwinkle, is an important medicinal plant of the family Apocynaceae. It is an evergreen shrub or herbaceous plant growing to 1 m. tall. The flowers are white to dark pink with a dark red centre, with a basal tube about 2.5- 3 cm. long and a corolla about 2-5 cm. diameter with five petal like lobes.

Experimental

Pink coloured *Catharanthus roseus* flowers were collected from its plant. These flowers were mixed with distilled water in 10%w/v ratio and heated to extract the color of flowers. This extract was used as indicator in pH metric titration of 0.1M HCl→0.1M NaOH. For it 10mL of 0.1M HCl as titrand was mixed with 50 mL of double distilled water in a beaker followed by addition of 5.0 mL of freshly prepared *Catharanthus roseus* flower extract as natural indicator. The end point of mentioned solution system using 0.1M NaOH as a titrant was measured using pH meter. The colour change at different pH values (ranged between 0 and 11 pH) of solution system was recorded. To find out the authenticity of obtained results using natural indicator it was standardized with the help of synthetic indicators- phenolphthalein (1% w/v in ethanol) and methyl orange (1% w/v in ethanol) for the same system.

Results and Discussion

The obtained experimental indicator was light green in color. The pH metric titration of 0.1M HCl→0.1M NaOH using this indicator shows the variation in color sequenced from pink→colorless→green and greenish yellow for the pH range below 3.0, 3.0 to 4.3, 4.31 to 5.9 and above 5.9, respectively (Table 1). These practical results were compared with theoretical pH values[8] of different titrations like strong acid and strong base (0.01, 0.1 and 1M HCl with same concentration of NaOH); weak acid and strong base (0.1M CH_3COOH with 0.1M NaOH); and weak base and strong acid (0.1M NH_4OH with 0.1M HCl). In each case 100ml volume of this acid-base titration was considered. At equivalence point the pH jump occurred from 3.30 to 10.70, 4.30 to 9.70 and 5.30 to 8.70 during the titration of 1MHCl→1MNaOH, 0.1MHCl→0.1 MNaOH and 0.01MHCl→0.01MNaOH, respectively (Table-2). Prepared natural indicator shows colour change at equivalence point as greenish yellow from pink via colourless in 1MHCl→1MNaOH and 0.1MHCl→0.1MNaOH titrations and via green colour in 0.01MHCl→0.01MNaOH

titration (Table-1) which proves its suitability for this acid-base titration. We got same end point in HCl→NaOH volumetric titration using phenolphthalein and prepared natural indicator separately. Similarly, at equivalence point, in titration of NH_4OH→HCl, the pH jump is occurred from 6.3 to 4.3 (Table-2) and prepared natural indicator shows colour change from greenish yellow to green at equivalence point which suggests that prepared natural indicator is most suitable for NH_4OH→HCl titration. We got same end point in NH_4OH→HCl volumetric titration using methyl orange and prepared natural indicator separately. On the contrary at equivalence point in titrations of CH_3COOH→NaOH, the pH jump is occurred from 7.7 to 9.7 (Table-2) whereas the prepared natural indicator shows colour change (Greenish yellow from pink) before the equivalence point which suggests that prepared natural indicator is not suitable for CH_3COOH→NaOH titration. The color change in natural indicator at different pH values is due to the change in structures of pH sensitive compounds like flavanoids and anthocyanine derivatives present in flower[9-13]. Flowers of *Catharanthus roseus* contains Malvidin, Hirsutidin, Petunidin, Rosindin (anthocyanine derivatives) and Kaempferol and Quercetin (Flavonoids)[14-15] which confirms color change at different pH.

Table 1 Different colours at different pH values of solution system during the pH metric titration of 0.1M HCl→ 0.1M NaOH using *Catharanthus roseus* indicator

pH of solution	Colour of solution
0 < pH < 3.0	Pink
3.0 ≤ pH < 4.3	Colourless
4.3 ≤ pH < 5.9	Green
5.9 ≤ pH	Greenish yellow

Table 2 pH of solution of various stages during different neutralisation titrations

Volume of titrant (mL)	pH of solution				
	Titration of 100mL of xM HCl with xM NaOH			Titration of 100mL of 0.1M CH_3COOH with 0.1M NaOH	Titration of 100mL of 0.1M NH_4OH with 0.1M HCl
	X=1	X=0.1	X=0.01		
0.0	0.0	1.0	2.0	2.9	11.1
50	0.5	1.5	2.5	4.7	9.3
90	1.3	2.3	3.3	5.7	8.3
99	2.3	3.3	4.3	6.7	7.3
99.5	2.6	3.6	4.6	7.0	7.0
99.8	3.0	4.0	5.0	7.4	6.6
99.9	3.3	4.3	5.3	7.7	6.3
100	7.0	7.0	7.0	8.7	5.3
100.1	10.7	9.7	8.7	9.7	4.3
100.2	11.0	10.0	9.0	10.0	4.0
100.5	11.4	10.4	9.4	10.4	3.6
101	11.7	10.7	9.7	10.7	3.3
110	12.7	11.7	10.7	11.7	2.3

Conclusion

It can be concluded from the study that due to presence of pH sensitive compounds in flowers of *Catharanthus roseus* their water extract can be used successfully in acid-base titrations of HCl→NaOH and NH_4OH→HCl but it failed to use for CH_3COOH→NaOH titration.

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