The Pharmaceutical and Chemical Journal, **2018, 5(5):88-92**

Available online ***www.tpcj.org***

Research Article

ISSN: 2349-7092
CODEN(USA): PCJHBA

A Study on Acid – Base Indicator Property of Flowers of Impatiens Balsamina

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Abstract Indicators are used to determine the equivalence point in acid – base titrations (neutralization titrations). They exhibit sharp color change with respect to change in pH. Popularly used indicators for neutralization titrations are synthetic chemicals. They are found to have hazardous effects in human body. The highly colored pigments obtained from plants are found to exhibit color changes with variation in pH. A study was done to check the indicator action of aqueous extract of flower pigments and compared with that of already existing synthetic indicators. Extraction was done using hot water and a definite volume of extract was added which gave accurate and reliable results for different types of neutralization titrations - strong base against strong acid, strong acid against a weak base, weak base against strong acid and weak acid against weak base. The work proved to be acceptable in introducing flower pigments as a suitable substitute to the synthetic indicators.

Keyword: Impatiens balsamina, pH indicators, flower pigments, neutralization indicators, phenolphthalein substitutes

Introduction

Impatiens Balsamina

Impatiens balsamina is an annual plant which grows to 20-75 cm height, has a thick, but soft stem, belonging to the family, balsaminaceae. The plant has spirally arranged leaves that are 2.5-9 cm long and 1- 2.5 cm broad with a deeply toothed margin. The flowers of Impatiens balsamina are pink or red, with a size of 2.5-5 cm diameter. Pollination is done through bees and other insects and also by nectar feeding birds. The ripe seed capsules undergo explosive dehiscence.

Different parts of the plant are used as traditional remedies for various disease and skin application. Juice from the leaves is used to treat warts and snake bite and the flower is applied to burns. It is also an inhibitor of 5α – reductases, enzymes that reduce testosterone levels.

pH Indicators

These are the organic dyes which exhibits different colors in varying pH [1]. They are very much useful for the identification of equivalence point in neutralization titrations [1]. Besides their application in titrations, they are used to identify the nature of identify the pH of medium. They are found to change their color during a particular stage of a reaction [2]. Certain examples for the popularly used indicators in chemical labs include Methyl orange, Methyl Red, Phenolphthalein etc [3].

Selection of an indicator for a neutralization titration depends on the consideration of neutralization curve. Any indicator whose effective working range falling between the vertical portion of the sigmoid shaped neutralization curve can be chosen as the indicator for that titration [4].

Theory of Indicators

There are mainly two theories which explain the principle of indicator function. These are the Ostwald theory and the Quinonoid theory. According to Ostwald, every acid – base indicator is either a weak acid or a weak base, having an equilibrium maintained between their dissociated and undissociated forms. The color of the indicator in dissociated form differs from that of its un dissociated form.

$HIn = H^+ + In^-$

The stress felt by the equilibrium upon addition of an acid or a base is adjusted by its shift towards either of the side, causing either dissociated or undissociated form to dominate, a practical application of Le Chatlier's principle [5].

The color corresponding to the dominated form will be then exhibited by the indicator [6].

Quinionid theory explains the structural changes undergone by an indicator during the change in pH of the medium. As per this theory, indicators exist as benzenoid – quinoniod equilibrium, and there will be dominance towards a particular form according to the change in pH values. It shows the lightest form in benzenoid existence and the darkest form in quinonid existence. Accordingly Phenolphthalein is quinonoid in alkaline pH and benzenoid in acid pH, but for Methyl orange and Methyl red it is the other way round.

Harmful Effects

Most of the indicators used nowadays are of synthetic origin. These are man made indicators. They suffer various demerits, majority of which belong to their toxic effects [7,8]. Besides their harmful health effects, they are also expensive and less available. It has been reported that the synthetic indicators causes environmental pollution particularly soil pollution. Some of their health hazards include hypoglycemia, pancreatitis, pulmonary edema, diarrhea, abdominal cramps and skin rashes [9]. Studies done on organic man made indicators like phenolphthalein, methyl orange helped to identify their toxic and hazardous effects [10]. The objective of the present study is to find a suitable substitute to replace the organic indicators and to introduce flower pigments as indicators in neutralization titrations.

Methodology

Plant Materials

The fresh flowers of Impatiens Balsamina were collected from the medicinal garden of KVM College of Pharmacy, Cherthala of Kerala, India. The authentification of the specimen was done at Department of Pharmacognosy, KVM College of Pharmacy.

Reagents

All the reagents used for the trials were assured to be of analytical grade and possessed standards. Sodium hydroxide, Ammonia, Hydrochloric acid, Ethanoic acid, and Phenolphthalein etc were procured from the store of KVM College of Pharmacy, Cherthala. All the reagents and volumetric solutions were prepared and standardized as per Indian pharmacopeia, IP 2014.

Glass wares

The glass wares in need of the trials included burettes, pipettes, volumetric flasks, etc. They were calibrated as per the guidelines of Indian pharmacopeia IP 2014.

Preparation of flower extract

1 g fresh flowers of Impatiens balsamina was accurately weighed. It was then cleaned by washing with fresh cold water. The extraction was done with warm water for 15 minutes. The aqueous extract was separated by filtration and was maintained.

Experimental

The flower petals of Impatiens balsamina were separated, cleaned with distilled water. It was then cut to small pieces, transferred to a clean, dry beaker. 100 ml of distilled water was taken in another dry beaker. It was gently warmed and poured to the petals. This was kept aside for 15 minutes. The extract was then poured carefully to the glass beaker through a funnel and stored separately without exposing to direct sunlight.

Test for color change

0.5 ml of the extract was added to 25 ml each of buffer solutions of pH ranging from 1.2 to 10.2. The results of the test are listed in table 1.

Table 1: Color change of indicator with pH change

Buffer solution	pH	Observed colour
Acid – phthalate buffer	3	Pink
Neutralized phthalate buffer	5	Pale pink
Phosphate buffer ,	7	Pale pink
Alkaline borate buffer	9	violet
Alkaline borate buffer	10	Dark violet

Titrations

The volume of the extract added as indicator for each titration type was 0.5mL. All the four types of neutralization titration, viz. Strong base against Strong acid, Strong acid against Weak base, Weak base against Strong acid and Weak acid against Weak base. The titrations were repeated five times to check the precision of the results obtained. The titrations were repeated using standard Phenolphthalein indicator and the results obtained were compared with the results of titrations using plant extract indicator.

The results for titrations are shown in the tables 2a to 5 b.

Table 2a): Titration of HCl against NaOH

No	Volume of acid (mL)	Burette Reading		Titre value (mL) (£x/n)	Indicator	End point
		Initial	Final			
1	10	0	9.9	9.88	Aqueous Flower extract	Appearance of violet colour
2	10	0	9.9			
3	10	0	9.8			
4	10	0	9.9			
5	10	0	9.9			

Table 2b): Titration of HCl against NaOH

No	Volume of acid (mL)	Burette Reading		Titre value (mL) (£x/n)	Indicator	End point
		Initial	Final			
1	10	0	9.9	9.88	phenolphthalein	Appearance of pale pink colour
2	10	0	9.8			
3	10	0	9.9			
4	10	0	9.9			
5	10	0	9.9			

Table 3a): Titration of HCl against NH_3

No	Volume of acid(mL)	Burette Reading		Titre value (mL) (£x/n)	Indicator	End point
		Initial	Final			
1	10	0	9.7	9.7	Aqueous Flower extract	Appearance of violet colour
2	10	0	9.6			
3	10	0	9.7			
4	10	0	9.8			
5	10	0	9.7			

Table 3b): Titration of HCl against NH_3

No	Volume of acid(mL)	Burette Reading		Titre value (mL) (£x/n)	Indicator	End point
		Initial	Final			
1	10	0	9.7	9.7	phenolphthalein	Appearance of pale pink colour
2	10	0	9.6			
3	10	0	9.7			
4	10	0	9.8			
5	10	0	9.7			

Table 4a): Titration of Acetic acid against NaOH

No	Volume of acid(mL)	Burette Reading		Titre value (mL) (£x/n)	Indicator	End point
		Initial	Final			
1	10	0	9.5	9.46	Aqueous Flower extract	Appearance of violet colour
2	10	0	9.5			
3	10	0	9.3			
4	10	0	9.5			
5	10	0	9.5			

Table 4b): Titration of Acetic acid against NaOH

No	Volume of acid(mL)	Burette Reading		Titre value (mL) (£x/n)	Indicator	End point
		Initial	Final			
1	10	0	9.6	9.46	phenolphthalein	Appearance of pale pink colour
2	10	0	9.6			
3	10	0	9.4			
4	10	0	9.6			
5	10	0	9.4			

Table 5a): Titration of Acetic acid against NH_3

No	Volume of acid (mL)	Burette Reading		Titre value (mL) (£x/n)	Indicator	End point
		Initial	Final			
1	10	0	9.7	9.68	Aqueous Flower extract	Appearance of violet colour
2	10	0	9.6			
3	10	0	9.7			
4	10	0	9.7			
5	10	0	9.7			

Table 5b): Titration of Acetic acid against NH_3

No	Volume of acid(mL)	Burette Reading		Titre value (mL) (£x/n)	Indicator	End point
		Initial	Final			
1	10	0	9.7	9.66	phenolphthalein	Appearance of pale pink colour
2	10	0	9.7			
3	10	0	9.7			
4	10	0	9.6			
5	10	0	9.6			

Results and Discussion

A study was conducted to identify the acid – base indicator property of flower pigments and their application in neutralization titrations as a substitute for the synthetic indicators used usually. Reports suggestive of the health hazards possessed by the synthetically prepared indicators and other disadvantages like their increased cost, poor availability and their role in causing environmental pollution create a necessity to move on to adoption of suitable alternatives which would overcome the disadvantages.

Flowers of Impatiens balsamina plant were identified to produce color changes with variation in pH values. The pigments were extracted by simple maceration method using luke warm water as the solvent. The extract was checked for its color change by adding it to standard buffer solutions of varying pH. Results obtained paved the way for its application in titrations.. The extract was used as the indicator for all the four types of neutralization titrations. A reference titration was done to check the accuracy of the titre value using Phenolphthalein as indicator .The equivalence point of the titrations using the flower extract either coincided or almost reached closer to the equivalence point using the standard indicator, phenolphthalein for all the four types of titrations. In certain cases it proved to be more reliable than the standard indicator and gave sharp color change at equivalence point. It was also observed that the extract acted reversibly and gave sharp color change in both the directions.

Conclusion

The study helped to realize that the limitations possessed by synthetic indicators could be easily overcome by substituting flower pigments. Flowers of Impatiens balsamina could be effectively used as a substitute to the popular synthetic indicators owing to the factors like ease of preparation, good performance and accurate and precise results. The fear of health hazards of synthetic indicators will not haunt the analyst during titrations when extract of Impatiens balsamina flowers are used in place of Phenolphthalein, Methyl orange etc.

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