

A Study on Acid – Base Indicator Property of Flowers of *Leucas zeylanica*Sajin Kattuvilakam Abbas^{1*}, Anusha Jose Gilbert², Shifana Shams²¹Assistant Professor, K.V.M. College of Pharmacy, Cherthala, Kerala, India²Final B Pharm, K.V.M. College of Pharmacy, Cherthala, Kerala, India**Original Research Article*****Corresponding author**
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Abstract: Indicators are used to determine the equivalence point in acid – base titrations (neutralization titrations). They show sharp color change with respect to change in pH. Popularly used indicators for neutralization titrations are synthetic chemicals. They are found to possess 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 acid against strong base, strong acid against a weak base, weak acid against strong base and weak acid against weak base. The work proved to be acceptable in introducing flower pigments as a suitable substitute to the synthetic indicators.

Keywords: *Leucas zeylanica*, pH indicators, flower pigments, neutralization indicators, phenolphthalein substitutes.

INTRODUCTION*Leucas zeylanica*

Leucas zeylanica is an annual herb commonly found throughout the state of Kerala, India. It is otherwise known as Ceylon slitwort. It is known by various names in vernacular languages. The Malayalam word for *Leucas zeylanica* is, 'thumba'. It has gained wide acceptability and popularity among people of tropical region owing to its medicinal properties. The plant is identified to have anti – microbial action and hence is grown with interest by people.

The parts of *Leucas zeylanica* rich in active medicinal moiety is the root and the leaf. It belongs to the family, Lamiaceae. The flower of the plant is white colored.

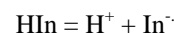
pH Indicators

These are the organic dyes which exhibit 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 undissociated form.



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 Chatelier's principle [5]. The color corresponding to the dominated form will be then exhibited by the indicator [6].

Quinonoid 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 – quinonoid 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 quinonoid 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 *Leucas zeylanica* were collected from the medicinal garden of KVM College of Pharmacy, Cherthala of Kerala, India. The authentication 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 petals of *Leucas zeylanica* 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 *Leucas zeylanica* 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 beaker. It was gently warmed and poured to the petals. This was kept aside for 15 minutes. The extract was then poured carefully to a glass container through a funnel and stored separately without exposing to direct sunlight.

Test for color change

0.1 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-5.

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 acid against Strong base, Strong acid against Weak base, Weak acid against Strong base 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 1a to 4b.

Table-1a: Titration of HCl against NaOH

No	Volume of acid (mL)	Burette Reading		Titre value (mL) (\bar{x}/n)	Indicator	End point
		Initial	Final			
1	10	0	9.9	9.88	Aqueous Flower extract	Disappearance of yellow colour
2	10	0	9.9			
3	10	0	9.8			
4	10	0	9.9			
5	10	0	9.9			

Table-1b: 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-2a: Titration of HCl against NH₃

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	Disappearance of yellow colour
2	10	0	9.6			
3	10	0	9.7			
4	10	0	9.8			
5	10	0	9.7			

Table-2b: Titration of HCl against NH₃

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-3a: 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	Disappearance of yellow colour
2	10	0	9.5			
3	10	0	9.3			
4	10	0	9.5			
5	10	0	9.5			

Table-3b: 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-4a: Titration of Acetic acid against NH₃

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	Disappearance of yellow colour
2	10	0	9.6			
3	10	0	9.7			
4	10	0	9.7			
5	10	0	9.7			

Table-4b: Titration of Acetic acid against NH₃

No	Volume of acid (mL)	Burette Reading		Titre value (mL) (fx/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			

Table-5: Color change of indicator with pH change

Buffer solution	pH	Observed colour
Acid – phthalate buffer	3	Bright yellow
Neutralized phthalate buffer	5	light yellow
Phosphate buffer ,	7	Pale yellow
Alkaline borate buffer	9	colourless
Alkaline borate buffer	10	colourless

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 *Leucas zeylanica* 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 close to the equivalence point using the standard indicator, phenolphthalein for all the titrations. In several 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 act reversibly and gave sharp color change in both the directions.

Thus the study helped to realize that the flower pigment of *Leucas zeylanica* could be effectively used as a substitute to the presently existing indicators owing to the factors like simple preparation, good performance and accurate and precise results.

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