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Short Communication

ECO-FRIENDLY NATURAL ACID-BASE INDICATOR PROPERTIES OF FOUR FLOWERING PLANTS FROM WESTERN GHATS

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ABSTRACT

Objective: The present study aims to evaluate the indicator property of ethanolic extract of the flowers of the *Quisqualis indica* L, *Pentas lanceolata, Melastoma malabathricum* L and *Impatiens acaulis*

Methods: Four different types of Acid-base titrations such as strong acid against the strong base, strong acid against a weak base, weak acid against the strong base and weak acid against weak base were carried out in the present study. Two acids (HCl and CH_3COOH) and two bases (NaOH and NH_4OH) were selected for acid-base titration. 0.1N strength of these acids and bases were used.

Results: The titration values were very close with an equivalence point obtained by standard indicator phenolphthalein

Conclusion: The work proved to be acceptable in introducing natural pigments as a substitute to the synthetic acid-base indicators by adopting the principles of green chemistry.

Keywords: Quisqualis indica L.**,** Pentas lanceolata, Melastoma malabathricum L., Impatiens acaulis, Flavonoids, Natural pigments, Acid-Base titration

In acid-base titrations, Indicators are used to determine the end point (equivalence point). The indicator shows sharp color change with respect to a change in pH. Commonly used indicators for acid-base titrations are synthetic. Each indicator exhibits a different range of colors at different pH values [1]. They are found to possess hazardous effects in the human body and pollute the environment. They are slightly expensive and are unavailable, so an attempt is made to prepare natural indicator from plant parts. Over the past few years, a plethora of medicinal plants has been put to trial as the source of multifunctional green chemical agents. The highly colored pigments obtained from plants are found to exhibit color changes with variation of pH. Natural pigments are eco-friendly in nature [2].

Flavonoids are colored pigments that can be isolated from various parts of plants like flowers, fruits and are pH sensitive [3]. Flavonoids show remarkable changes in color with the change in pH due to this property; it gives an opportunity to use it as an acid-base titration indicator rather than the conventional synthetic indicators. Therefore, it has been hypothesized that the flower extract could be utilized as an indicator for different types of acid-base titrations [4].

Quisqualis indica L. is a creeper with red flower clusters also known as 'Rangoon creeper' belongs to the *Combretaceae* family native to Asia. *Pentas lanceolata* also known as 'Egyptian star cluster' is a species of flowering plant in *Rubiaceae* family that is native to Africa and Yemen. *Melastoma malabathricum* L. commonly known as 'lutki' is a flowering plant in the family *Melastomataceae*. *Impatiens acaulis* commonly known as 'rock balsam' that native to Western Ghats of India and Sri Lanka. Rutin and pelargonidin-3-glucoside were isolated the from flowers of *Quisqualis indica* [5]. The literature survey reveals that there is no literature related to acid-base indicator property of the above plant. Hence, the present study is to investigate the acid-base indicator property of the ethanolic extract of *Quisqualis indica* L., *Pentas lanceolata, Melastoma malabathricum* L. and *Impatiens acaulis* (fig.1) to establish analytical applications.

The flowers of *Quisqualis indica* L. was collected from Alto-Porvorim, Goa-403521. The flowers of *Pentas lanceolata* was collected from valpoi, Goa-403506. The flowers of *Melastoma malabathricum* L. and *Impatiens acaulis* were collected from Mangeli, Maharashtra-416512.

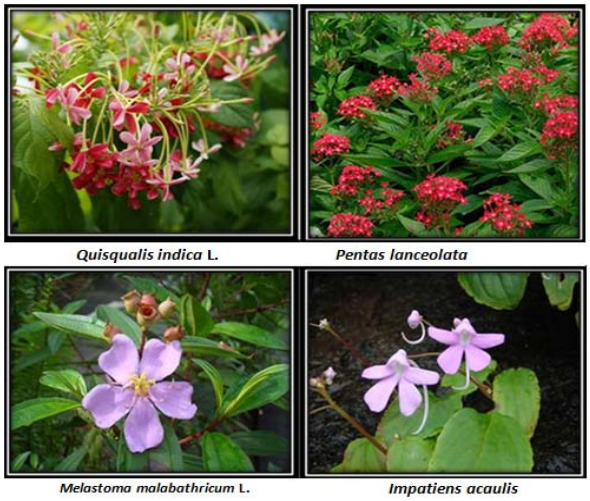


Fig. 1: Photograph of the selected plants

All the above plants were identified and confirmed by Prof. M. K. Janarthanan, Department of Botany, Goa University, Goa, India-403003.

All the chemicals and reagents used in this research work were of analytical or synthetic grade reagents like hydrochloric acid (HCl), Sodium hydroxide (NaOH), Acetic Acid (CH_3COOH), Ammonia (NH_3) and phenolphthalein, etc. was procured from Sigma Aldrich, E-Merck (Germany) and S D Fine Chemicals (India).

The fresh flowers of *Quisqualis indica* L. *Pentas lanceolata*, *Melastoma malabathricum* L. and *Impatiens acaulis* were cleaned with distilled water and cut into small pieces with the help of scissors separately [6]. Pieces of each flower were soaked in 25 ml ethanol for 24 h. The solution was filtered to remove remaining flower matter and subjected to evaporation to remove the solvent and used as an indicator in Acid-Base titrations. The extract was preserved in a tightly closed container and stored away from direct sunlight.

The ethanolic extracts of *Quisqualis indica* L. *Pentas lanceolata*, *Melastoma malabathricum* L. *Impatiens acaulis* flowers were used as a natural indicator in acid-base titrations [7]. The titration was carried out using of Strong acid, strong base, weak acid and a weak base. Titrations were done by using 0.1N HCl, 0.1N NaOH, 0.1N CH_3COOH and 0.1N NH_4OH. The results of the all the four types of acid–base titrations of were presented in table 1-2.

Preliminary phytochemical studies of ethanolic extracts of *Quisqualis indica* L., *Pentas lanceolata*, *Melastoma malabathricum* L., and *Impatiens acaulis* were performed according to published standard methods [8]. The results of preliminary phytochemical studies were presented in table 3.

The synthesized natural indicators were scanned for λ_{max} value by using UV–Vis spectrophotometer (UV 3000+Make LAB INDIA) and the results were presented in table 4.

The prepared indicator color showed that they contain color pigments. Even though *Impatiens acaulis* was a colorless solution, it also acts as a natural indicator since it has flavonoids.

A number of works were done to invent the natural indicator from plant materials [9] such as the methanolic extract of the flowers of *Tagetes erecta*, *Dianthus plumarius, Antirrhinum majus*, *Morus alba*, *Rosa indica*, *Punica granatum*, *Hibiscus rosa sinensis*, *Napoleona Vogelii* and *Catharanthus roseus,* etc.

Pasupuleti Sunitha *et al.* [10] reported the review on sixteen prudent indicators such as *Rosa indica, Hibiscus rosa sinesis, Nerium oleander, Catharanthus roseus, Antirrhinum majus, Dianthus plumarius,* Guinea Corn Leaves, *Punica granatum, Tagetes erecta, Dahlia pinnata,* Acalypha wilkesiana, *Impatiens balsamina, Morus alba, Citrullus lanatu*, *Caesalpinias appan, Beta vulgaris.*

Standardized 0.1N HCl, 0.1N NaOH, 0.1N CH_3COOH and 0.1N NH_4OH were used for the acid-base titrations. In acid-base titrations equivalence point obtained by ethanolic extracts of *Quisqualis indica* L., *Pentas lanceolata*, *Melastoma malabathricum* L. and *Impatiens acaulis* either exactly coincided or very closed to equivalence point obtained by standard indicator phenolphthalein. It was observed that indicators act reversibly and gave a sharp color change in both directions. This represented the usefulness of alcoholic flower extract as an indicator in acid-base titrations. It used in all the four types of acid-base titration were found to be more significant over the standard indicator as it gives sharp color change at the equivalence point.

Table 1: Titration of strong acid Vs strong base and weak acid Vs weak base

Titration		**0.1N HCl Vs. 0.1N NaOH**		**0.1N CH_3COOH Vs. 0.1N NH_4OH**	
Extracts	**Vol. of titre in ml**	**Vol. of titrant in ml (mean)**	**Endpoint**	**Vol. of titrant in ml (mean)**	**Endpoint**
Quisqualis indica L.	10	10.2	Pink-pale yellow	10.2	Pink-yellow
Pentas lanceolata	10	10.2	Pink-light green	10.4	Pink-colorless
Melastoma malabathricum	10	10.1	Pink-pale yellow	10.4	Colorless-yellow
Impatiens acaulis	10	10.2	Pink-pale yellow	10.2	Pink-light green
Phenolphthalein	10	10.1	Colorless-light pink	10.2	Colorless-light pink

n=3

Table 2: Titration of strong acid Vs weak base and weak acid Vs strong base

Titration		**0.1N HCl Vs. 0.1N NH_4OH**		**0.1N CH_3COOH Vs 0.1N NaOH**	
Extracts	**Vol. of titre in ml**	**Vol. of titrant in ml (mean)**	**Endpoint**	**Vol. of titrant in ml (mean)**	**Endpoint**
Quisqualis indica L.	10	9.6	Yellow-light pink	10.0	Pink-pale yellow
Pentas lanceolata	10	9.5	Yellow-light pink	10.1	Pink-pale yellow
Melastoma malabathricum	10	9.6	Yellow-light pink	10.1	Colorless-pale yellow
Impatiens acaulis	10	9.6	Yellow-light pink	10.1	Pink-yellow
Phenolphthalein	10	9.7	Pink-colorless	10.1	Colorless-light pink

n=3

Table 3: Preliminary phytochemical screening of ethanolic extracts of natural indicators

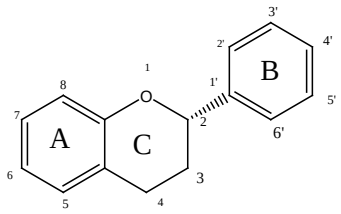
Tests	**Ethanolic extract of *Quisqualis indica***	**Ethanolic extract of *Pentas lanceolata***	**Ethanolic extract of *Melastoma malabathricum***	**Ethanolic extract of *Impatiens acaulis***
Alkaloids	+	+	+	+
Flavonoids	+	+	+	+
Anthroquinones	-	-	-	-
Saponins	-	-	-	-
Steroids	+	+	+	+
Terpenoids	+	+	+	+
Glycosides	+	+	-	+
Carbohydrates	+	+	+	+
Phenolic compounds	+	+	+	+
Proteins	-	-	-	-
Amino acids	+	+	+	+
Triterpenoids	+	+	+	+
Tannins	+	+	+	+

(+) Present (-) Absent

Preliminary photochemical investigation of ethanolic extracts of *Quisqualis indica* L., *Pentas lanceolata*, *Melastoma malabathricum* L. and *Impatiens acaulis* were presented in table 3. It showed the presence of flavonoids in all the four natural Indicators.

The presence of flavonoids especially Anthocyanins are characterized by two absorption bands Band I-475-560 nm (visible region) and Band II-275-280 nm (UV region) support the acid-base indicator property of four flower extracts [3] such as *Thespesia populnea, Nerium odorum, Thunbergia alata* and *Helianthus annus.* UV-Visible absorption spectra of the ethanolic extract of the plants *Cassia aungostifolia, Thevetia peruviana* and *Thevetia thvetiodes* showed the characteristic bands in the UV and Visible region confirms the presence of flavonoids [11] which contributed the acid-base indicator properties.

Ultraviolet and visible spectroscopy was one of the earliest techniques routinely used for flavonoid analysis due to the existence of two characteristic UV-Visible bands in flavonoids [12]. Generally, flavonoids structure (fig. 2) shows two bands. A band I, in the 300 to 550 nm range, arising from the B ring and band II in the 240 to 285 nm range, arising from the A ring.



Flavonoids

Fig. 2: General structure of flavonoids

Table 4: UV–Vis spectra analysis of natural indicators

Ethanolic extracts	$\lambda_{max\ in\ nm}$		Absorbance	
	UV	Visible	UV	Visible
Quisqualis indica	242	402	0.652	0.356
Pentas lanceolata	246	536	0.601	0.362
Melastoma malabathricum	256	402	0.654	0.339
Impatiens acaulis	250	-	0.650	-

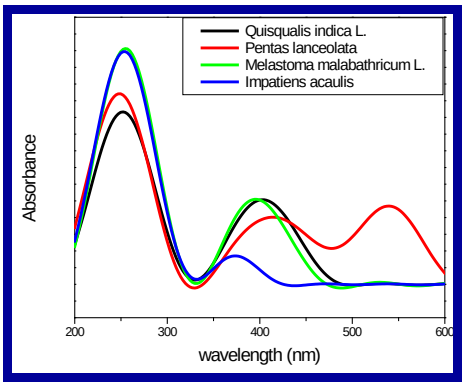


Fig. 3: UV-Vis spectrum of natural indicators

From table 4, it is clear that all the four indicators shown the λ_{max} value within this region of flavonoids (fig. 3). Both the preliminary phytochemical studies and UV-Vis spectral studies confirm the presence of flavonoids, which may be the reason for its activity as an indicator. Apart from the above advantages the isolation of pure compounds possessing indicator's properties helps to know the mechanism by which they show the indicator's properties and new theories of indicators could be established.

The synthetic indicators are very hazardous to health and cause pollution, therefore, to solve this problem flower extract has been selected as a source of indicator for acid-base titration. The accuracy of the results has been judged by performing a variety of acid-base titration.

Thus, the study helped to realize that the flower pigment of *Quisqualis indica L., Pentas lanceolata, Melastoma malabathricum* L. and *Impatiens acaulis* 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 and can be prepared just before the experiment.

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CONFLICT OF INTERESTS

Declared none

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