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USE OF *COMBRETUM INDICUM* FLOWER EXTRACT AS A NATURAL INDICATOR IN ACID-BASE TITRATION

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Keywords:

Combretum indicum, Ethanolic extract, Acid-base titration, Natural indicator, End point

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ABSTRACT

Natural alternatives to synthetic chemicals are the demand of contemporary chemistry regarding environmental pollution crisis. There is need to develop green indicator as effective alternative for synthetic indicators used in laboratory. A change in colour with variation in pH is due to presence of coloured pigments therefore they are used in acid base titrations to show sharp end point. Commonly used indicators for neutralization titrations are synthetic in nature. They are found to posses' hazard effects in human body. The highly coloured pigments obtained from plants are found to exhibit colour changes with change in pH. Present study suggested the use of *Combretum indicum* flower ethanolic extract as a natural indicator for acid-base titration. The natural indicator is prepared from the ethanolic extract of *Combretum indicum*. Two acids (HCL & CH_3COOH) & two bases (NaOH & NH_4OH) were selected for acid base titration. 0.1N, 0.5N, 1N, 5N strength of these acid & bases were prepared. Colour intensity of ethanolic extract of *Combretum indicum* from family Combretaceae was compared with Phenolphthalein, Methyl red, Methyl orange, Mixed indicator & this indicators are evaluated by Strong acid - Strong base, Strong acid – Weak base, weak acid – Strong base, and Weak acid – Weak base. The end point obtained by the flower extract coincides with the end point obtained by standard indicator. The use of natural indicator is cheap as it is easily available, simple to extract, environmentally & user friendly & found to be excellent substituent for standard indicators.

INTRODUCTION

The indicators are halo chromic chemical compound that is added in small amount to a solution, so that the pH (acidity or basicity) of the solution can be determined visually. pH indicators find many applications in biology & analytical chemistry. Common application of indicator is the detection of end point of titration. It can be detected by observing change in colour of indicator. Indicators are used in the low concentration in titration & do not have any influence on detection for which they recommended [9]. Indicators are dyes or pigments that can be isolated from a variety of sources, including plants, fungi, & algae. For e.g. Red, blue, or purple in colour contains class of organic pigments called anthocyanin that change colour with pH. The use of natural dye as acid-base indicators was first reported in 1664 by Sir Robert Boyle in his collection of assays. Indeed, Boyle made an important contribution to the early theory of acids & bases by using indicators for the experimental classification of these substances [2]. The extract of leaves, fruits or seed are pH sensitive & give different colours in acidic & basic condition. The pH indicators are substances whose solutions change colour due to changes in pH. These are also called as acid-base indicators or neutralization indicators [1]. They are usually weak acids or weak bases, but their conjugate base or acid forms have different colours due to differences in their absorption spectra. Indicators are complicated organic weak acids or bases with complicated structures. For simplicity, we represent a general indicator formula "HIn" for acidic indicators & "In OH" for basic indicator [8, 9]. Titration is the process for ascertaining the exact volume of one solution that is chemically equivalent to given amount of another substance, either another solution or a given amount of solid material dissolved in a solvent [9]. The apparatus usually used in titrations is burette if solution of an acid is titrated with a solution of base, the equivalence point, the point at which chemically equivalent quantities of acid & base have been mixed, can be found by means of an indicator. This allows for quantitative analysis of the concentration of unknown acid or base solution. Synthetic indicators have certain disadvantage like high cost, availability & chemical pollution hence natural indicators obtained from varies plant part like flowers, fruits, leaves etc. will be more advantageous. All pH indicators, such as litmus paper, changes colours depending upon whether they donate or accept protons, (acids are proton donors & bases are proton acceptors). Therefore, pH indicators are themselves acid or base. Indicators work because they are weak acids which, when in solution, exist in equilibrium with their base. There are various organic & inorganic compounds responsible for natural colours [9].

Chemical Indicator:-

Any substance that gives visible sign usually by a colour change on presence or absence of a threshold concentration of a chemical species such acid or alkali in a solution. E.g. Methyl yellow which imparts a yellow colour as an alkaline solution. The common application of indicator is the detection of end point of titration [9].

Indicators are therefore classified as,

- Acid base indicator
- Oxidation-reduction indicator

Some commonly used indicators,

- Phenolphthalein
- Methyl red
- Methyl orange
- Congo red
- Mixed indicators

Why a Natural indicator:-

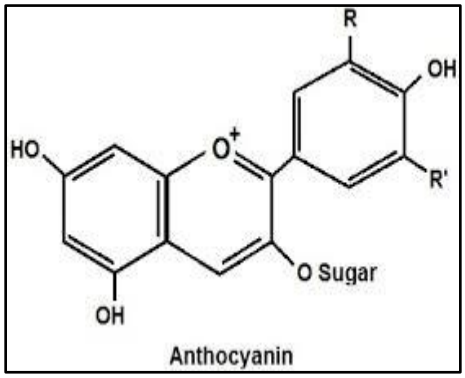
Many more indicators are used in titration to detect the end point but such chemical indicators are found to be very expensive & hazardous as well. So, we tried to prepare indicator from natural source like plant part- leaves, seed, and flowers. As these plants are very common & easily available, as well as indicators obtained from them are found to be economic & eco-friendly. & the results are same as compared to synthetic indicators.

A visual acid-base indicator is just like a weak acid with differently colored acid & conjugate base form. Flower & leaf pigments often fit this description. Few of the chemical constituents responsible for colour change are as follows,

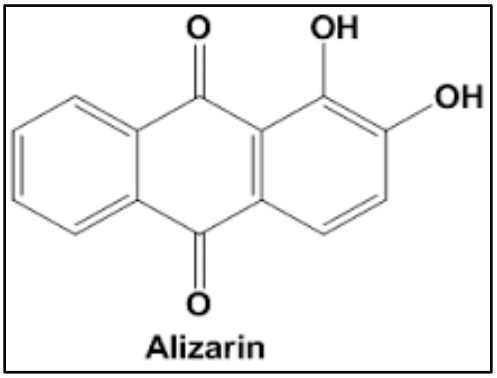
- Alizarin is an orange dye present in the root of the madder plant; it was used to dye wool in ancient Egypt, Persia & India. In a 0.5% alcohol solution, alizarin is yellow at pH 5.5 & at pH 6.8. Several synthetic modifications of alizarin as also used as acid-base indicators.
- Cochineal is an acid-base indicator made from the bodies of dried female cochineal insects, found in Mexico & Central America. The powder is about yellow in acidic solution & basic in alkaline solution.
- Curcumin is a dye found in curry powder. It turns from yellow at pH 7.4 to Red at pH 8.6.

- Esculin is a fluorescent dye that can be extracted from leaves & bark of the horse chestnust tree. Esculin changes from colourless at pH 1.5 to fluorescent blue at pH 2
- Litmus is a blue dye extracted from various species of lichen. As though these lichens grow in many parts of the world, almost all litmus is extracted & packaged in Holland. Litmus is red at pH 4.5 & blue around pH 8.3.
- Anthocyanin is probably the most readily available acid-base indicator; it is the plant pigment that makes red cabbage purple, cornflower blue & poppies red. It changes colour from red in acid solution to purple in mild alkaline solution

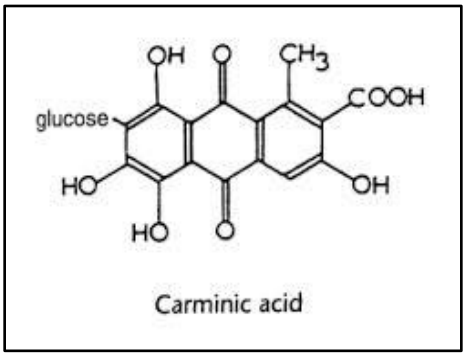
Few of the chemical constituents responsible for colour change are as follows,



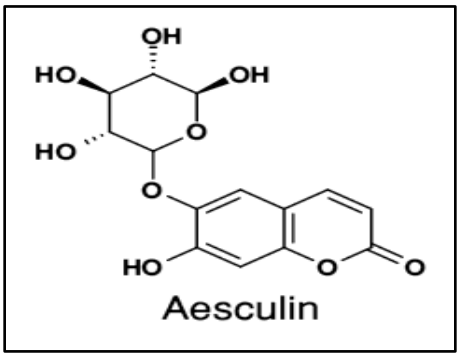
Anthocyanin



Alizarin



Carminic acid



Aesculin

Figure 1. ***Combretum indicum***

Botanical name : *Combretum indicum*.

Synonyms : Quisqualis indica L.

Common names : Chinese honeysuckle, Rangoon creeper.

Classification

Kingdom : Plantae

Order : Myrtale

Family : Combretaceae

Genus : Combretum

Species : *C. indicum*

Description : Chinese honeysuckle/ Rangoon creeper, red flower cluster commonly Found in Asia, cultivated ornamental or wild.

Use : It is used as herbal medicine & show potent antihelmintic activity

MATERIALS & METHOD

a) Plant materials:

The fresh flowers of *Combretum indicum* species were collected & authenticated. Collected flowers of *Combretum indicum* cleaned with water & cut into very small pieces by chopping blender. The juice is stained off from the resulting much also extracted with ethanol to yield more pigments. Finally solution is filtered to remove remaining plant matter & used as natural indicator [1, 2, 8,].

b) Chemicals:

- Sulphuric acid
- Sodium hydroxide
- Acetic acid
- Ammonium hydroxide
- Phenolphthalein
- Methyl red
- Ethanol

c) Glassware's:

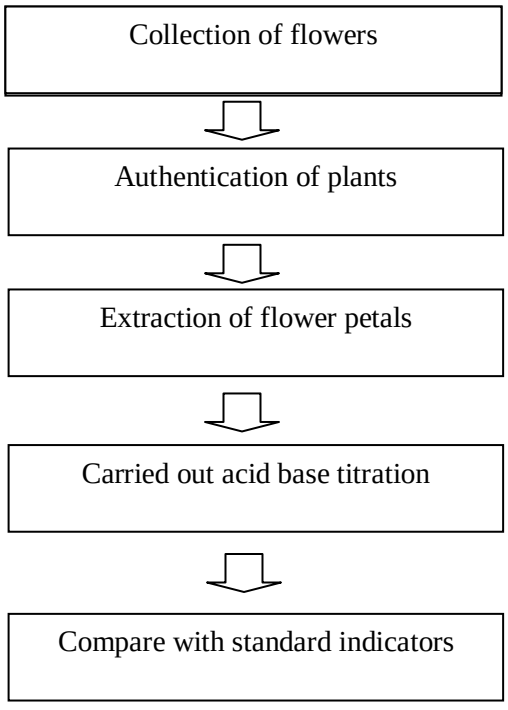
- pH meter
- Conical flask
- Burette

- Pipette
- Test tubes
- Beaker

d) General procedure:

1) Analytical grade reagents were made available through Satara College of Pharmacy, Degaon, Satara.
2) Reagents & volumetric solutions were prepared as per official books.
3) The fresh plant species were collected & authenticated.
4) The flowers of plant were collected & cleaned with water.
5) Cleaned flower petals were cut in small pieces with help of chopping blender.
6) Chopped petals are macerated for 4 hrs with 100 ml solution of ethanol. After pressing the mark, filtrate was collected & this filtrate was used as indicator.
7) The titrations were performed using 10ml titrant with three drops of indicator & titrated with NaOH/NH_4OH. Standard deviation is calculated by using mean of first three titration.

e) Schematic procedure:



RESULT & DISCUSSION

For all types of titrations equivalence point obtained by ethanolic extract of *Combretum indicum* was found to be nearly closed with equivalence point by standard indicators. This represents the usefulness of alcoholic flower extract as an indicator in acid-base titration.

Titrant	Titrate	Standard indicator	Flower extract
HCl	NaOH	Yellow to Pink (methyl red)	Greenish yellow to Light pink
HCl	NH_4OH	Yellow to Pink (methyl orange)	Greenish yellow to Light pink
CH_3COOH	NaOH	Pink to Colourless (Phenolphthalein)	Greenish yellow to Light pink
CH_3COOH	NH_4OH	Orange to Blue (Mixed Indicator)	Greenish yellow to Light Pink

Table 1: Technological characterization for analysis & comparisons of colour change.

Titration	Strength (M)	Indicator	Mean of three titrations
HCl vs NaOH	0.1	Methyl Red	11 ml
		Flower extract	11.5 ml
	0.5	Methyl Red	11.2ml
		Flower extract	11.4ml
	1	Methyl Red	11.2ml
		Flower extract	11.6ml
	5	Methyl Red	11ml
		Flower extract	11.4ml

Table 2: Technological characterization for analysis & comparisons of colour change.

Titration	Strength (M)	Indicator	Mean of three titrations
HCl vs NH_4OH	0.1	Methyl orange	03 ml
		Flower extract	3.5 ml
	0.5	Methyl orange	03ml
		Flower extract	4.4ml
	1	Methyl orange	3.5ml
		Flower extract	04ml
	5	Methyl orange	3.2ml
		Flower extract	3.5ml

Table 3: Technological characterization for analysis & comparisons of colour change.

Titration	Strength (M)	Indicator	Mean of three titrations
CH_3COOH vs NaOH	0.1	Phenolphthalein	9.2 ml
		Flower extract	9.5 ml
	0.5	Phenolphthalein	9.2ml
		Flower extract	9.4ml
	1	Phenolphthalein	10.5ml
		Flower extract	10.8ml
	5	Phenolphthalein	9.2ml
		Flower extract	9.5ml

Table 4: Technological characterization for analysis & comparisons of colour change.

Titration	Strength (M)	Indicator	Mean of three titrations
CH_3COOH vs NH_4OH	0.1	Mixed indicator	4.4 ml
		Flower extract	5.6 ml
	0.5	Mixed indicator	4.2ml
		Flower extract	4.4ml
	1	Mixed indicator	3.5ml
		Flower extract	4ml
	5	Mixed indicator	3.2ml
		Flower extract	3.5ml

Table 5: Technological characterization for analysis & comparisons of colour change.

CONCLUSION

From results obtained in all types of acid-base titrations lead us to conclude that, the synthetic indicators could be replaced successfully by flower extract. As they are easily available, cheep, accurate & precise & can be prepared just before the experiment by simple maceration process.

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