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Der Pharma Chemica, 2013, 5(1):296-299
(http://derpharmachemica.com/archive.html)

ISSN 0975-413X
CODEN (USA): PCHHAX

Comparative study of natural and synthetic indicators

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ABSTRACT

Today synthetic indicators are the choice of acid-base titrations. But due to environmental pollution, availability and cost, the search for natural compounds as an acid-base indicator was started. The present vocation highlights the exploit of the acidified methanolic extract of the flowers of few medicinal plants as an acid-base indicator in acid-base titrations. This natural indicator is easy to extract as well as easily available. Promising results were obtained when it was compared against standard synthetic indicators. Titration shows sharp color change at the equivalence point. The equivalence points obtained by the flowers extract coincide with the equivalence points obtained by standard indicators. These natural indicators are found to be a very useful, economical, simple and accurate for the said titration.

Keywords: Acid-base indicator, Natural indicator, Titration, Anthocyanins.

INTRODUCTION

Indicator solution is a substance that has a different color on acid, alkaline, and neutral. Akibatnya, larutan tersebut dapat digunakan untuk membedakan larutan asam, basa, dan netral. As a result, the solution can be used to distinguish acid, alkaline, and neutral. Some of the indicators commonly used in laboratories, among other fenolflatein solution (pp), red metal, and orange metal [(1)]

The term titrimetric analysis refer to quantitative chemical analysis carried out by determining the volume of solution of accurately known concentration which is required to react quantitatively with a measured volume of a solution of the substance to be determined. In this experiment, some of these indicators will be extracted. The pH's at which the indicators change color will be investigated [(2).] Acid (often represented by the general formula HA) is generally a chemical compound that when dissolved in water will produce a solution with a pH less than 7. In the modern definition, an acid is a substance that can give a proton (H + ions) to other substances (called bases), or may receive a free electron pair of the bases. An acid reacts with a base in a neutralization reaction to form a salt. Acids have a sour taste and are corrosive or damaging the metal.General definition of the bases are chemical compounds that release hydroxide ions (OH -) when dissolved in water. Base is the opposite of acid, which is intended to elements / compounds that have a pH more than 7.Many substances around us that can be used as an indicator of acid and alkali. For example, leaf, flower, turmeric, mangosteen skin, and purple cabbage. This is because the solution of these materials give a different color on acid and alkaline and neutral. To prove this, mangosteen skin that has been refined in a neutral state would be purple. However, if the added acid solution, the color purple will change to reddish brown. Conversely, if the alkaline solution is added, the color of the skin extract of mangosteen will change from purple to blue-black. With these color changes, skin extract of mangosteen can be used as an indicator of acid and alkali [(3)]. The object of carrying out an acid-base titration is to determine the equivalent quantity of the other substance required for neutralization. The point at which complete neutralization is achieved is called as the 'end point'or the 'equivalence point'.if both the acid and base are strong electrolytes the resulting solution will be neutral having pH=7. But if either of the two is a weak electrolyte the resulting salt formed will hydrolyse to some extent and solution will possess some acidic or alkaline properties. Indicator is a substance which exhibits colour change at a particular stage of chemical reaction(4). Almost any flower, for example, that is red, blue, or purple in color contains a class of organic pigments called anthocyanins that change color with pH. The use of natural dyes as acid-base indicators was first reported in 1664 by Sir Robert Boyle in his collection of essays Experimental History of Colors. Indeed, Boyle made an important contribution to the early theory of acids and bases by using indicators for the experimental classification of these substances (5).

Family Rosaceae and Hibiscus rosa-sinensis (L) from family Malvaceae gives sharp and intense color change as compared to phenolphthalein and methyl orange. Herbal indicators are evaluated by using strong acid - strong base, strong acid - weak base, weak acid - strong base, and weak acid - weak base. In all these titrations the extract was found to be very useful and accurate for indicating the equivalence point (neutralization point)(6) .

Nerium oleander L. (Apocyanaceae) is evergreen, glabrous shrub upto 6 m high, native of the Mediterranean region and extending as far as Iran. It is often grow in Indian gardens for ornament and also as fence and wind-break. Flowers of the plant are salver-shaped, pink or white, scentless, present as terminal cymes. Leaves, flowers and stem bark possess cardiotonic properties. Small amount of glycosides and alkaloids are present in flowers. Flowers yield 0.03 % of an essential oil (7) .Nerium oleander is an evergreen shrub or small tree in the dogbane family Apocynaceae, toxic in all its parts. It is the only species currently classified in the genus Nerium. It is most commonly known as oleander, from its superficial resemblance to the unrelated olive Olea, but has many other names (8).

MATERIALS AND METHODS

Fresh flowers were collected from the local gardens of satara regions, maharashtra, and they were authenticated from Yashavanrao chavan science college botany department,sartar.All other ingredients were of analytical grade and purchased from Loba Chemie Pvt Ltd, Mumbai.

The flowers were cleaned by distilled water and cut into small pieces and macerated for 20 mins in 25ml of 90% ethanol. The extract was preserved in tight closed container and stored away from direct sun light. The experiment was carried by using the same set of glassware's for all types of titrations. As the same aliquots were used for both titrations i.e. titrations by using standard indicators and flowers extract, the reagents were not calibrated. The equimolar titrations were performed using 10 ml of titrant with three drops of indicator. All the parameters for experiment are given in Table 1. A set of four experiments each for all the types of acid base titrations were carried out. The mean and standard deviation for each type of acid base titrations were calculated from results obtained. The extract was also analysed for its max wavelength in Ultra Voilet range on single beam spectrophotometer (Shimadzu UV 1800). Strong acid-strong base (HCl - NaOH), strong acid- weak base (HCl - CH3COOH), weak acid-strong base (CH3COOH - NaOH) and weak acid-weak base (CH_3 cooh0 - NH_3) are listed in [Table]. Each titration is carried out three times by using 1N strength of acid and alkali and results were recorded as mean ± SEM.

RESULTS

The extract was found to contain compound anthocyanins as it gives colors as mentioned in table no.1

Table 1 : Acid base titration chart

Titration (Titrant v/s Titrate)	Synthetic Indicators	Mean ±S.D.*	Color change	Natural indicators	Mean ±S.D.*	Color change	PH
Hcl vs NaOH	MR	22.2	Pink to yellow	H.rs	20.0	Orange to green	12.0-6.33
	MO	23.6	Orange to pink	C.rs	8.0	Orange to Colourless	12.53-5.0
	PT	24.5	Colourless to pink	N.ol	7.0	Orange to Colourless	12.8-2.5
HCl v/s NH4OH	MR	4.5	Pink to yellow	H.rs	2.7	Orange to green	10.0-3.0
	MO	4.1	Orange to pink	C.rs	3.5	Orange to green	10.82-1.58
	PT	3.9	Colourless to pink	N.ol	1.9	Orange to Colourless	11.11-1.94
CH_3COOH v/s NaOH	MR	31.4	Red to orange	H.rs	7.7	Pink to Colourless	12.8-7.8
	MO	31.8	Yellow to red	C.rs	4.5	Pink to Colourless	12.8-7.0
	PT	31.1	Colourless to pink	N.ol	3.2	Pink to Colourless	12.74-8.6
CH_3COOH v/s NH4OH	MR	3.5	Pink to yellow	H.rs	1.5	Pink to Colourless	11.0-7.0
	MO	4.6	Orange to pink	c.rs	0.9	Pink to Colourless	11.0-6.5
	PT	4.1	Colourless to pink	N.ol	0.8	Pink to Colourless	11.6-6.5

MR:methyl red, MO:methyl orange, PT:phenolphthalein, HCl: Hydrochloric acid, CH3COOH: Acetic Acid, NaOH: Sodium Hydroxide, NH4OH: Ammonium Hydroxide, H.rs:Hibiscus Rosa sinensis, c.rs:Catharanthus Roseus, n.in:Nerium indicum,SD-standard deviation,FA-free of alkaloids

CONCLUSION

The results obtained in all the types of acid-base titrations lead us to conclude that, it was due to the presence of flavonoids sharp color changes occurred at end point of the titrations. Neutralization points obtained by methanolic extract of Nerium oleander,Catharanthus roseus and Hibiscus rosa-sinensis were very closed with equivalence point obtained by standard indicators phenolphthalein,methyl red and methyl orange. This represents the usefulness of alcoholic flower extract as an indicator in acid base titrations. Titrate and titrant with indicators showed sharp and intense color change at the equivalence point that is at neutralization [(9).]

Its use in strong acid-strong base titration was found to be more significant over standard indicator as it gives sharp color change at equivalence point as results obtained showed that the routinely used indicators could be replaced successfully by flower extract as they are simple, accurate, economical and precise and can be prepared just before experiment. The proposed herbal indicators can be used as a substitute to synthetic indicators. We can also conclude that, it is always beneficial to use N. oleander, c.roseus, h.roseus flowers extract as an indicator in all types of acid base titrations because of its economy, simplicity and wild availability. Means, based on Bronsted-Lowry acid base theory the proton from the hibiscus extract received by OH ions $^-$ thus causing color changes [(10)] .

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