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A REVIEW ON PRUDENT INDICATORS

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ABSTRACT

In an attempt of quantitative analysis of drugs neutralization titrations are done where the end point is generally detected by synthetic indicators like phenolphthalein etc, but the synthetic indicators are uneconomical, hazardous causing environmental pollution. To overcome the above difficulties, herbal indicators are introduced and are gaining more importance in the quantitative analysis. Pigments that are present in various parts of plants of different families were found to be amphoteric and possess indicator action equivalent to that of the synthetic indicator. This article highlights the research done on economical and safe herbal indicators used in acid base titrations

Keywords: Quantitative analysis, Neutralization titration, synthetic indicator, Herbal indictor

Introduction:

Neutralization titrations [2] are performed with standard solutions of strong acids or bases which are used for estimation of concentration of an acid or base by exactly neutralizing acid or base. When strong acid reacts with strong base the solution will have neutral pH, strong acid reacts with weak base the solution will have acidic pH and, weak acid reacts with strong base the solution will have alkaline pH. An indicator [3] must be used to detect the end point where neutralization has taken place. The equilibrium [1] between the acidic form In_A and the basic form of In_B may be expressed as

$$\mathbf{In_A \leftrightarrow H^+ + In_B}$$

Observed colour of an indicator in solution is determined by the ratio of concentration of acidic and basic forms In_A / In_B. Natural colors are biodegradable and decays aerobically or nonaerobically, hence easily removed from environment. Anthocyanins are water soluble pigments belonging to the flavanoid group of phytochemicals which occurs in leaves, stems. roots flowers and fruits. The colour of anthocyanins depends on acidity of the medium. at acidic pH. 1-3, anthocyanidins exist predominantly in the form of red flavylium cation. Increasing the pH, leads to decrease in colour intensity and the concentration of flavylium ion which undergoes hydration to produce the carbinol pseudobase.

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The conjugated 2-benzopyrilium system is disrupted due to nucleophilic attack of water at the second position of anthocyanidin skeleton. A rapid proton loss of the flavylium cation takes place as the pH is raised. Now the equilibrium is shifted towards a purple quinoidal anhydrobase at pH less than 7 and a deep blue ionized anhydrobase at pH. 8. When pH is further increased the carbinol form converts to chalcone. Herbal indicators are evaluated by using acid base reactions and the results are compared with synthetic indicators.

General procedure for extraction of anthocyanins:

Anthocyanins[7] [8] are commonly extracted by maceration process. Maceration[6] [9] involves placing suitably powdered material in a closed vessel and the solution is allowed to stand aside for several hours with occasional shaking. The liquid is strained off and clarified by means of filtration. Commonly used solvent is acidified methanolic solution. Methanol is commonly used solvent for extraction because of its low boiling point that allows rapid concentration of the extract.

Fig. 1: Maceration

Following are some of the extracts that possess indicator action. The endpoints obtained by herbal indicators are exactly coinciding with that of synthetic indicators.

1. ***Rosa indica*[10] [11]:**

Fig. 2

Rosa indica belongs to the family of Rosaceae possess indicator action due to the presence of anthocyanins. The petals of flower were cleaned by using distilled water and cut into small pieces and macerated for 24 hours in 10 ml of methanol. The results are tabulated in Table 1 and 3.

2. ***Hibiscus rosa sinesis*[10] [12] :**

Fig. 3

Hibiscus rosasinesis belongs to the family of Malvaceae. The petals of flower were cleaned by using distilled water and cut into small pieces and macerated for 24 hours in 10 ml of methanol. The results obtained were very close to synthetic indicators. The results are tabulated in Table 2 and 3.

3. ***Nerium oleander*[13] [14]:**

Fig. 4

Nerium oleander is an evergreen shrub or small tree in the dogbane family Apocynaceae. It is the only species currently classified in the genus Nerium.

It is most commonly known as oleander. Flowers of the plant are salver-shaped, pink or white, scentless, present as terminal cymes. The flowers were cleaned by distilled water and cut into small pieces and macerated for 20 minutes in 25ml of 90%ethanol. The results are tabulated in Table 4.

4. Catharanthus roseus [13] [15]:

Fig. 5

Catharanthus roseus belongs to the family Apocynaceae. Petals were macerated for 15 min with 20 ml of methanol. After pressing the mark, filtrate was collected. By repeating same procedure with same solvent the extract was concentrated. Finally extract was filtered and used as indicator. The results are tabulated in Table 4.

5. *Antirrhinum majus*[16] [17]:

Fig. 6

Antirrhinum majus belongs to the family Scrophulariaceae commonly known as dog plant. Petals were macerated for 24 hours in methanol. The results are tabulated in Table 5 & 6.

6. *Dianthus plumarius* [16] [18]:

Fig. 7

Dianthus plumarius belongs to the family Caryophyllaceae. Petals were macerated for 24 hours in methanol. The results are tabulated in Table 5&6.

7. Guinea Corn Leaves [19] [20]:

Fig. 8

Guinea corn leaves popularly called "waakye leaves" in Ghana It belongs to the family Poaceae. The plant materials (leaves) were ground into powdered form. The powder was sieved into an amber bottle and stored away from direct sun-light to prevent photolysis and decomposition. The natural indicator extract was prepared by weighing approximately 1.01 g of a powdered sample leaves into a Pyrex culture test tube (20 × 250 mm) and 25.0 ml of ethanol (99.9%) added. The mixture was vortexed for5 minutes at ambient temperature (25˚C) and then filtered using Whatman No. 4 filter paper into a new culture test tube of the same size. The results are tabulated in Table 7.

8. *Punica granatum*[21] [22]:

Fig. 9

It is commonly called pomegranate belongs to the family of Punicaceae. The fruits were cleaned and cut into small pieces. 100gm of these pieces were macerated with 150 ml of solution containing 9 parts of methanol and 1part of dilute hydrochloric acid for 3 hrs. The results are tabulated in Table 8 & 9.

9. *Tagetes erecta* [23] [24]:

Fig. 10

The plant *Tagetes erecta* locally known as Marigold belongs to the family Asteraceae.The fresh flowers were cleaned and cut into small pieces. 100gm of these pieces were macerated with 150 ml of solution containing 9 parts of methanol and1 part of dilute hydrochloric acid for 3 hrs. The results are tabulated in Table 10 & 11.

10. *Dahlia pinnata* [25] [26]:

Fig. 11

Dahlia pinnata is a species of the genus dahlia, belonging to the family Asteraceae. Flowers were cleaned by distilled water, petals of these flowers were kept in strong sunlight until they get completely withered. The dried petals were grinded into fine powder with a mechanical blender. Dried powder of petals were soaked in 40 ml methanol for 48 hours and then triturated in mortal and pestle and the resulting solution was filtered through muslin cloth. The resulted methanolic extract was further used as natural indicator. The results are tabulated in Table 12 & 13.

11. Acalypha wilkesiana[27] [28]:

Fig. 12

It belongs to the family Euphorbiaceae and is evergreen shrub; it is commonly called as copper leaf. Collected leaves of Acalypha wilkesiana cleaned with water and cut into very small pieces by chopping blender. The juice is stained off from the resulting mush also extracted with water to yield more pigment. Finally solution is filtered to remove remaining plant matter and used as natural indicator. The results are tabulated in Table 14 & 15.

12. *Impatiens balsamina*[29] [30]:

Fig. 13

It belongs to the family Balsaminaceae is commonly known as Garden or Annual balsam.Adequate amount of the fresh petals of Impatiens balsamina was collected, cleaned followed by maceration with sufficient alcohol for 48 hrs. The results are tabulated in Table 16.

13. *Morus Alba*[31] [32]:

Fig. 14

Morus alba linn belonging to the family Moraceae (Urticaceae); it is commonly called as whiteMullberry; toola; tuk; shetu. The fruits were cleaned and cut into small pieces.100 gm of these pieces were macerated with 150 ml of solution containing 9 parts of methanol and 1 part of dilute hydrochloric acid for 45 min. The results are tabulated in 17 & 18.

14. citrulluslanatus [33]:

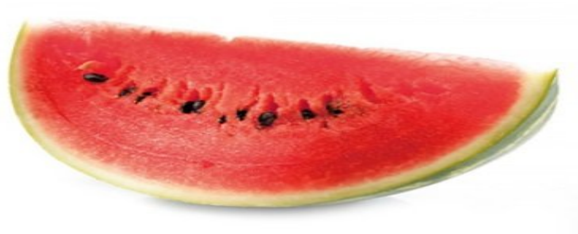

Fig. 15

It belongs to the family Cucurbitaceae, commonly known as water melon. Pulps of the fruit are pH sensitive and give different colours in acidic condition (pink) and in basic conditions (dark greenish). Distilled water fruit extract of *Citrus lanatus* gives sharp and intense colour The results are tabulated in Table 19.

***15. Caesalpiniasappan*[34] [35]:**

Fig. 16

It belongs to the family Caesalpiniaceae. The natural indicator was prepared as an aqueous extract. Heartwood of 10g sappan wood was boiled with 100ml water for 3 minutes and filtered. *Caesalpiniasappan (Caesalpiniaceae*) whose heartwood is widely being used in drinking water for its anti-thirst, blood purifying, ant diabetic and several other properties is nowadays being used as a coloring agent for wine, meat, fabric etc.. The results are tabulated in Table 20.

***16. Beta vulgaris*[36] [37]:**

Fig. 17

It belongs to the family Chenopodiaceae, commonly known as beet root, table beet or garden beet. The chopped beet root should be added to the solution ethanol: hydrochloric acid (99:1) and boil the solution. Later after cooling the beet root is squashed and the liquid was filtered. For all the titrations the results were equivalent to the synthetic indicators like phenolphthalein, methyl red and methyl orange. The results are tabulated in Table 21.

Table 1: Rosa indica

Titrant	Indicator	Colour	Titrate	Colour(End point)
HCl	Rosa indica	Colourless	NaOH	Pink
CH_3COOH	Rosa indica	Colourless	NaOH	Pink
HCl	Rosa indica	Colourless	NH_3	Pink
CH_3COOH	Rosa indica	Colourless	NH_3	Pink

Table 2: Hibiscus rosa sinesis

Titrant	Indicator	Colour	Titrate	Colour(End point)
HCl	Hibiscus rosa sinesis	Colourless	NaOH	Violet
CH_3COOH	Hibiscus rosa sinesis	Colourless	NaOH	Violet
HCl	Hibiscus rosa sinesis	Colourless	NH_3	Violet
CH_3COOH	Hibscus rosa sinesis	Colourless	NH_3	Violet

Table 3: Volume of titrate with standard indicator

Chemicals		**Volume of titrate required for equivalent point with titrant (10ml) with indicator**		
Titrant (1N)	Titrate (1N)	Standard indicator	Rosa indica	Hibiscus rosa sinesis
HCl	NaOH	10.1 ±2	10.1 ±0.39	10 ±0.46
CH_3COOH	NaOH	9.5 ±0.35	9.8 ±0.41	9.5 ±0.26
HCl	NH_3	9.8 ±0.62	10 ±1.02	9.5 ±0.44
CH_3COOH	NH_3	10 ±0.40	10.02 ±0.15	9.7 ±0.57

Table 4: Experimental screening of Catharanthus roseus and Nerium oleander

Titration (Titrant vs Titrate)	Synthetic indicator	Mean ± S.D*	Colour change	Natural indicator	Mean + or – S.D*	Colour change	pH
HCl Vs NaOH	MR	22.2	Pink to yellow				
	MO	23.6	Orange to pink	Catharanthus roseus	8.0	Orange to colourless	12.53 - 5.0
	PT	24.5	Colourless to pink	Nerium oleander		Orange to colourless	12.8 – 2.5
HCl Vs NH_4OH	MR	4.5	Pink to yellow				
	MO	4.1	Orange to pink	Catharanthus roseus		Orange to green	10.82 – 1.58
	PT	3.9	Colourless to pink	Nerium oleander		Orange to colourless	11.11 – 1.94
CH3COOH Vs NaOH	MR	31.4	Red to orange				
	MO	31.8	Yellow to red	Catharanthus roseus		Pink to colourless	12.8 – 7.0
	PT	31.1	Colourless to pink	Nerium oleander		Pink to colourless	12.74 – 8.6
CH3COOH Vs NH_4OH	MR	3.5	Pnk to yellow				
	MO	4.6	Orange to pink	Catharanthus roseus		Pink to colourless	11.0 – 6.5
	PT	4.1	Colouress to pink	Nerium oleander		Pink to colourless	11.6 – 6.5

MR – Methly red, MO – Methyl orange, PT - Phenolphthalein HCl – Hydrochloric acid, CH_3COOH – Acetic acid, NaOH – Sodium Hydroxide, NH_4OH – Ammonium Hydroxide, SD – Standard Deviation

Table 5: Experimental screening of Antirrhinum manjus and Dianthus plumaris

Titrant	Indicator	Colour	Titrate	Colour (End point)	Indicator	Colour (End point)
HCl	Antirrhinum manjus	Colourless	NaOH	Pink	Dianthus plumaris	Violet
CH3COOH	Antirrhinum manjus	Colourless	NaOH	Pink	Dianthus plumaris	Violet
HCl	Antirrhinum manjus	Colourless	NH_3	Pink	Dianthus plumaris	Violet
CH3COOH	Antirrhinum manjus	Colourless	NH_3	Pink	Dianthus plumaris	Violet

Table 6: Volume of titrate with standard indicator

Chemicals		Volume of the titrate required for equivalent point with titrant (10ml) with indicator		
Titrant (1N)	Titrate (1N)	Standard indicator	Antirrhinum manjus indicator	Dianthus plumaris
HCl	NaOH	10.5 ± 0.3	10.2 ± 0.21	10.4 ± 0.31
CH_3COOH	NaOH	9.5 ±0.55	9.7 ± 0.25	9.5 ± 0.23
HCl	NH_3	10 ±0.52	9.5 ± 0.25	10.2 ± 0.52
CH_3COOH	NH_3	9.5 ±2.4	9.7 ± 0.01	9.4 ± 0.25

Table 7: Physical and chemical parameters of the indicators used for titration

Acid	Base	Indicator colour change and pH of Sorghum vulgare Extract	Indicator colour change and pH of Standard		
HCl	NaOH	Yellow to light pink (1.0 -12.0)	Reddish to yellow (1.0 – 12.0) (MO)	Colourless to pink (1.0 – 12.0) (PH)	Light pink to orange (1.0 – 12.0) (MR)
CH_3COOH	NaOH	Yellow to light pink (4.0 – 12.0)	Reddish to yellow (4.0 – 12.0) (MO)	Colourless to pink (4.0 – 12.0) (PH)	Light pink to orange (6.0 – 12.0) (MR)
CH_3COOH	$NaHCO_3$	Yellow to light pink (4.0 – 8.0)	Reddish to yellow (4.0 – 12.0) (MO)	nd	Light pink to orange (2.0 - 12.0) (MR)
HCl	$NaHCO_3$	Yellow to light pink (1.0 – 9.0)	Reddish to orange (1.0 – 8.0) (MO)	nd	Light pink to orange (1.0 - 9.0) (MR)

PH- Phenolphthalein, MO- Methyl orange, MR-Methyl Red, nd – not determined

Table 8: Parameters for titration – Punica grantum.

Titrant	Titrand	Indicator colour change and (pH range)	
		Standard	Fruit Extract
HCl	NaOH	Colourless to pink (PH)	Pink to colourless
HCl	NH_3	Red to yellow (MR)	Pink to colourless
CH_3COOH	NaOH	Colourless to pink (PH)	Pink to colourless
CH_3COOH	NH_3	Yellow to red (PR)	Pink to colourless

PH – Phenolphthalein MR- Methyl Red PR- Phenol Red

Table 9: Mean volume (in ml) at equivalence point for titrations

Strength (in M)	HCl v/s NaOH		HCl v/s NH_3		CH_3COOH v/s NaOH		CH_3COOH v/s NH_3	
	PH	FE	PH	FE	PH	FE	PH	FE
0.1	7.8 ±0.20	7.7±0.24	7.4±0.20	7.5±0.62	7.9±0.20	7.8±0.24	9.2±0.30	9.1±0.32
0.5	8.0±0.40	7.9±0.32	7.8±0.24	7.7±0.34	8.1±0.24	8.2±0.42	9.4±0.42	9.3±0.42
1.0	10.2±0.3	10.0±0.34	9.5±0.30	9.4±0.36	9.8±0.30	9.9±0.34	10±0.60	10±0.32

Mean of five titrations ± S.D, Key: M- Molar strength, PH- Phenolphthalein, MR- Methyl Red, FE- Fruit Extact, PR- Phenol red.

Table 10 Parameters of titration Tagetes erecta

Titrant	**Titrand**	**Indicator colour change and (pH range)**	
		Standard	Flower extract
HCl	NaOH	Colourless to pink (PH)	Light orange to colourless
HCl	NH3	Red to Yellow (MR)	Orange to colourless
CH3COOH	NaOH	Colourless to pink (PH)	Orange to Light Green
CH3COOH	NH3	Yellow to red (PR)	Orange to Colourless

Table 11: Mean volume (in ml) at the equivalence point for titrations

Strength (M)	**HCl v/s NaOH**		**HCl v/s NH_3**		**CH_3COOH v/s NaOH**		**CH_3COOH v/s NH_3**	
	PH	FE	PH	FE	PH	FE	PH	FE
0.1	7.6±0.19	7.5±0.13	7.4±0.20	7.2±0.23	7.9±0.20	7.8±0.14	9.2±0.30	9.1±0.26
0.5	8.1±0.39	8.1±0.32	7.8±0.24	7.6±0.32	8.1±0.24	8.0±0.32	9.4±0.42	9.3±0.31
1.0	10.1±0.31	10.2±0.12	9.5±0.30	9.4±0.31	9.8±0.30	9.7±0.30	10.0±0.60	10.1±0.42

Table 12: colour changes in neutralization titration – Dahlia pinnata

Indicator	Titant	Colour	Titrate	Colour
Dahlia pinnata	HCl	Pink	NaOH	Green
Dahlia pinnata	CH_3COOH	Pink	NaOH	Green
Dahlia pinnata	HCl	Pink	NH_3	No visible colour change
Dahlia pinnata	CH_3COOH	No visible colour change	NH_3	No visible colour change

Table 13: Comparision of Dahlia pinnata with synthetic indicator

Chemicals used		Volumes of titrates required for equivalence point with titrant (25ml) with indicator	
Titrant	Titrate	Standard indicator	Dahlia indicator
HCl	NaOH	25.1 ± 0.2	24.4 ± 0.43
CH_3COOH	NaOH	24.5 ± 0.35	24.8 ± 0.28
HCl	NH_3	24.8 ± 1.02	
CH_3COOH	NH_3	25.0 ± 0.40	

Table 14: Screening of Acalypha wilkesiana leaves

Titrant	Titrand	Indicator colour change (pH range)	
		Standard	Leaves extract
HCl	NaOH	Green to Pink (4 – 6)	Pink to Green(4.5 – 7)
HCl	NH3	Pink to Colourless (6.6 – 8)	Green to Violet (3 – 5)
CH3COOH	NaOH	Green to Pink (4.5 – 6)	Pink to Green (4.2 – 5.5)
CH3COOH	NH3	Pink to Colourless (4-6)	Green to Violet (4.6 – 6)

Table 15: Experimental screening of Acalypha wilkesiana

Titration	Strength	Indicator	Acalypha wilkesiana
			Mean ± S.D (n = 3)
HCl vs NaOH	0.1	Methyl red	16.16 ± 0.28
		Leaves extract	16.46 ± 0.25
	0.5	Methyl red	08.70 ± 0.34
		Leaves extract	08.80 ± 0.15
	1.0	Methyl red	07.90 ± 0.36
		Leaves extract	07.70 ± 0.4
	5.0	Methyl red	08.20 ± 0.05
		Leaves extract	08.30 ± 0.10
HCl vs NH_4OH	0.1	Phenolphthalein	43.0 ± 0.15
		Leaves extract	45.36 ± 0.55
	0.5	Phenolphthalein	36.43 ± 0.50
		Leaves extract	35.73 ± 0.46
	1.0	Phenolphthalein	22.33 ± 0.50
		Leaves extract	23.00 ± 0.28
	5.0	Phenolphthalein	18.40 ± 0.11
		Leaves extract	18.20 ± 0.36
CH_3COOH vs NaOH	0.1	Methyl red	04.36 ± 0.40
		Leaves extract	04.46 ± 0.35
	0.5	Methyl red	02.63 ± 0.05
		Leaves extract	02.6 ± 0.05
	1.0	Methyl red	02.23 ± 0.25
		Leaves extract	02.40 ± 0.02
	5.0	Methyl red	02.80 ± 0.10
		Leaves extract	02.80 ± 0.05
CH_3COOH vs NH_4OH	0.1	Methyl red	14.06 ± 0.15
		Leaves extract	13.93 ± 0.09
	0.5	Methyl red	16.23 ± 0.25
		Leaves extract	16.23 ± 0.15
	1.0	Methyl red	08.76 ± 0.25
		Leaves extract	08.46 ± 0.2
	5.0	Methyl red	14.90 ± 0.10
		Leaves extract	15.00 ± 0.30

Table 16: Experimental screening of Impatiens balsamina

TItation	Strength	Indicator	Mean ± S.D	Colour change
HCl/ NaOH	0.1 0.5 1.0	Phenolphthalein	4.33±0.288 6.10±1.10 4.10±0.10	Colourless to pink
	0.1 0.5 1.0	Methyl Red	5.167±0.288 4.533±0.152 4.133±0.152	Pinkish red to yellow
	0.1 0.5 1.0	Methyl Orange	4.90±0.10 5.967±0.208 3.7±0.10	Reddish orange to yellowish brown
	0.1 0.5 1.0	Flower indicator	4.833±0.577 6.60±0.264 4.033±0.057	Light blue to yellow
CH_3COOH/ NaOH	0.1 0.5 1.0	Phenolphthalein	16.03±0.115 15.67±0.208 15.83±0.057	Colourless to pink
	0.1 0.5 1.0	Methyl Red	15.02±0.10 15.33±0.305 15.97±0.057	Pinkish red to yellow
	0.1 0.5 1.0	Methyl Orange	15.80±0.20 16.10±0.20 15.87±0.152	Reddish pink to yellow
	0.1 0.5 1.0	Flower indicator	16.07±0.115 16.43±0.115 15.73±0.115	Light blue to yellow
HCl / NH_4OH	0.1 0.5 1.0	Phenolphthalein	15.13±0.208 15.60±0.10 15.83±0.057	Colourless to pink
	0.1 0.5 1.0	Methyl Red	15.77±0.208 15.33±0.305 15.80±0.10	Pinkish red to yellow
	0.1 0.5 1.0	Methyl Orange	15.77±0.057 16.10±0.20 15.43±0.208	Reddish pink to yellow
	0.1 0.5 1.0	Flower indicator	15.37±0.115 16.10±0.20 15.43±0.208	Light blue to yellow
CH_3COOH/ NH_4OH	0.1	Phenolphthalein	3.56±0.057	Colourless to Pink
	0.5		2.86±0.152	
	1.0		3.0±0.10	
	0.1	Methyl Red	4.30±0.10	Reddish orange to Yellow
	0.5		3.40±0.10	
	1.0		3.467±0.115	
	0.1	Methyl Orange	4.23±0.057	Orange to Yellow
	0.5		3.43±0.057	
	1.0		5.63±0.152	
	0.1	Flower indicator	4.367±0.152	Light blue to Yellow
	0.5		3.167±0.0577	
	1.0		2.933±0.0577	

Table 17: Parameters for titration – Morus Alba

Titrant	Titrand	Indicator colour change and (pH range)	
		Standard	Fruit extract
HCl	NaOH	Pink to Colourless (8.2 – 10.0) (PH)	Blue to Pink (5.5 – 8.5)
HCl	NH3	Pink to Colourless (8.2 – 10.0) (PH)	Blue to Pink (5.5 – 8.5)
CH3COOH	NaOH	Pink to Colourless (8.2 – 10.0) (PH)	Blue to Pink (5.5 – 8.5)
CH3COOH	NH3	Yellow to Pink (4.2 – 6.3) (MR)	Blue to Pink (5.5 – 8.5)

PH = Phenolphthalein, MR= Methyl Red

Table 18: Mean volume (in ml) at the equivalence point for the titrations*

Strength (in M)	HCl/ NaOH		HCl/ NH3		CH3COOH/ NaOH		CH3COOH/ NH3	
	PH	FE	PH	FE	PH	FE	PH	FE
0.1	4.92±0.07	4.54±0.05	10.6±0.10	9.98±0.07	3.9±0.10	4.02±0.07	4.06±0.08	3.96±0.10
0.5	5.00±0.10	4.84±0.05	10.9±0.07	11.2±0.10	6.9±0.05	6.82±0.07	17.6±0.08	16.98±0.07
1.0	10.96±0.10	10.60±0.09	5.70±0.10	5.98±0.13	9.3±0.17	9.00±0.06	8.78±0.13	8.32±0.026

Mean of five titrations ± S.D, M= Molar Strength, FE= Fruit extract, PH= Phenolphthalein, MR= Methyl Red.

Table 19: Experimental screening of Citrus lanatus

Titration	Fruit extract	Phenolphthalein	End point
HCl/ NaOH	9.88	9.88	Colourless
HCl/ NH_3	9.78	9.56	Colourless
CH_3COOH/ NaOH	9.68	9.68	Colourless
CH_3COOH/ NH_3	9.58	9.68	colourless

Table 20: Comparison with Synthetic indicator - Caesalpiniasappan

Chemicals used		Volumes of titrates required for equivalence point with titrant (25ml) with indicator	
Titrant	Titrate	Standard indicator	Caesalpinisappan
HCl	NaOH	25.1±0.2	24.2±0.37
CH_3COOH	NaOH	24.5±0.35	24.3±0.40
HCl	NH_3	24.8±1.02	24.6±0.44
CH_3COOH	NH_3	25.0±0.40	25.6±0.52

Table 21: Experimental screening of Beta vulgaris

Titration	Phenolphthalein	Methyl Red	Methyl Orange	Indicator I	Indicator II
HCl/ NaOH	23.5	24.3	24	24	22.1
CH_3COOH/ NaOH	7.1	9	4.5	9.5	8
HCl/ NH_4OH	56	41.5	40.9	55.2	46.2
CH_3COOH/ NH_4OH	19.5	11.5	9.8	25	27.5

CONCLUSION:

Herbal indicators in quantitative analysis of drugs has gained importance which is evident from the extensive research work done and literature work showing these indicators have worthy advantages in terms of economy and safety for determination of the end points.

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REFERENCES:

1. Vogel's text book of Quantitative chemical Analysis sixth edition, 2008, Doring Kindersley, Pg 47 – 50
2. R.A. Day, Jr., A.L. Underwood – Quantitative Analysis sixth edition 2009, PH, Learning private limited, New Delhi, Pg 43, 128 – 147.
3. Lippincott Williams & wilkins, Remington The Scince and practice of Pharmacy Vol I 21st edition 2009, Pg 499 – 506.

4. Y. Anjaneyulu, K.Chandrasekhar, Valli Manickam, A Textbook of Analytical Chemistry, Pharma book syndicate, 2006, Hyderabad. Pg 81 – 100.
5. SS Agarwal, M. Paridhavi – Herbal Drug Technology, 2007, Universities press (India) Private Limited, Hyderabad, Pg 114 – 127.
6. Dr. S.H Ansari, Essential of Pharmacognosy, Birla publications Pvt Ltd, Delhi 2009. Pg -358 – 367, 370.
7. N. R. Krishnaswamy, Chemistry of Natural Products Universities Press (India) Private Limited, Hyderbad, 2010, Pg 17 – 34.
8. O. P Agrawal, Organic Chemistry Natural Products, Vol II, Goel publishing house, Meerut, Pg. 164 – 183, 184 – 199.
9. Pharmaceutical engineering k.sambhamurthy new age international limited publishers 175.
10. Vishwas C Bhagat[1], Radheshyam D Patil[1], PR Channekar[1], SC Shetty[1], Atul S Akarte[2] Herbal indicators as a substituent to synthetic indicators International journal of green pharmacy 2008 2 (3) 162-163
11. http://upload.wikimedia.org/wikipedia/en/b/b4/Cropped_Small_Red_Rose.JPG
12. http://en.wikipedia.org/wiki/Hibiscus#mediaviewer/File:Hibiscus_pink.jpg
13. Sarita Kadam, Adhikrao Yadav, Vijay Raje and *Karishma Waghmare comparative study of natural and synthetic indicators Der Pharma Chemica, 2013, 5(1):296- 299
14. http://upload.wikimedia.org/wikipedia/commons/2/21/Nerium_oleander_cultivars_in_Sedovo_4.jpg
15. http://www.spagyricmedicine.com/wordpress/wp-content/uploads/2013/04/catharanthus_roseus.jpg
16. sidana jaspreet,Arora kanika,nain parminder,deswalgeeta herbal indicatorsas an upcoming trend in titrimetric analysis international research journal of pharmacy 2(4)2011 177-179.
17. http://www.kerneliv.dk/en/snapdragon/496-antirrhinum-majus-nanum-black-prince-snapdragon.html
18. http://newfs.s3.amazonaws.com/taxon-images-1000s1000/Caryophyllaceae/dianthus-plumarius-fl-llandry-a.jpg
19. Daniel A. Abugri1, Ohene B. Apea2, Gregory Pritchett Investigation of a Simple and Cheap Source of a Natural Indicator for Acid-Base Titration: Effects of SystemConditions on Natural Indicators Green and Sustainable Chemistry, 2012, 2, 117-122
20. http://1.bp.blogspot.com/-btw4rFHk5Gg/T7aFgEf-rQI/AAAAAAAABxw/lyxmuAjF1ng/s1600/120518+how+to+dry+corn+husks+for+guinea+pigs3.jpg
21. Shubham Agrawal, Navin . R. Raj*, Kuldeep Chouhan, Chanchal N.Raj , Sameer Jain and A.Balasubramaniam Isolation of herbal acid-base indicator from the seeds of Punica granatum. Journal of Chemical and Pharmaceutical Research 2011, 3(2):168-171
22. http://www.dreamstime.com/stock-images-pomegranate-punica-apple-punica-granatum-l-fruit-has-health-benefits-image35438764
23. A. Elumalai*, M. Chinna Eswaraiah, Raju Kasarla, Palla Ravi An Alternative to Synthetic Acid Base Indicator-Tagetes erecta Linn Asian J. Research Chem. 5(2): February 2012, 218-220
24. http://www.benary.com/en/product/W1731 Tagetes erecta
25. Poonam Gupta, Pushpa Jain*, Pramod Kumar Jain Dahlia flower sap a natural resource as indicator in acidimetry and alkalimetry international journal of pharmacy & technology jan-2013 4 (4) 5038-5045
26. http://www.directgardening.com/large/7830_l.jpg - Dahlia pinnata
27. Savita H. Bhise*, Namdeo G. Shinde1, Bhagyashree S. Surve, Nayana V. Pimpodkar, Sanobar S. Shikalgar Acalypha wilkesiana as Natural pH Indicator International Journal of Natural Products Research h 2014; 4(1): 33-35
28. http://www.miracleexport.com/2012-06-27-13-39-05/plants/image.raw?view=image&type=orig&id=94 – Acalypha wilkesiana
29. Chinmoy Paul, Debarupa D. Chakraborty, Amitava Ghosh, Prithviraj Chakraborty Natural Indicator as a substitute to Synthetic indicator- A Developmental Approach. Journal of Applied Pharmaceutical Science Vol. 4 (09), pp. 120-122, September, 2014
30. http://ledgeandgardens.typepad.com/.a/6a00d8341c991c53ef0120a527afa0970b-800wi - Impatiens balsamina.
31. *K.S. Pathade , S.B. Patil, M.S. Kondawar, , N.S. Naikwade and C.S. Magdum Morus Alba Fruit- Herbal alternative to synthetic Acid Base indicators international Journal of ChemTech Research CODEN(USA): IJCRGG ISSN : 0974-4290 Vol.1, No.3 , pp 549-551, July-Sept 2009
32. http://keyserver.lucidcentral.org/weeds/data/03030800-0b07-490a-8d04-0605030c0f01/media/Html/Morus_alba.htm
33. http://1.bp.blogspot.com/-dzhAgV7845w/T9l8k87OWmI/AAAAAAAAAwU/8SfmV7XvDgg/s1600/IMG_1698.JPG - Citrulluslanatus.
34. Kavitha G*, Chinju Sara George, Ancy Alex, RakhiRaju, RiniBiju, Deepa T Vasudevan Herbal Indicators: An alternative to Synthetic Indicators International Journal of

Pharmaceutical and Phytopharmacological Research 2014; 3 (6): 434-435
35. http://cdn.tcmwiki.com/image/s/post-su-mu/su-mu2.jpg - Caesalpiniasappan
36. Mrs a.h sharma,pv powar Beetroot-herbal alternative to synthetic indicator in titrimetric analysis International journal of science and research 3(7),2014 676-679.
37. http://www.southernharvest.com.au/system/files/imagecache/seed_catalogue_large/Beetroot%20Detroit%20Red.jpg

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