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An Alternative to Synthetic Acid Base Indicator-Tagetes Erecta Linn

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ABSTRACT
The present work highlights the use of the methanolic extract of the flowers of Tagetes erecta as an acid-base indicator in acid-base titrations. This natural indicator is easy to extract as well as easily available. Indicators used in titration show well marked changes of colour in certain intervals of pH. Most of these indicators are organic dyes and are of synthetic origin. 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. 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 methanolic extract of the flowers of *Tagetes erecta* was found to be very useful, economical, simple and accurate for acid base titration.

Key words: Acid-base titration, *Tagetes erecta*, Herbal indicator, Methanolic extract

1. INTRODUCTION
An indicator is a substance that reveals through characteristic colour changes, the degree of acidity or basicity of solutions. Indicators are weak organic acids or bases which exist in more than one structural form (tautomers) of which at least one form is colour. Intense colour is desirable so that very little indicator is needed; the indicator itself will thus not affect the acidity of the solution. Acid-base indicators are commonly employed to mark the end of an acid-base titration or to measure the existing pH of a solution. The indicator range is the pH interval of colour change of the indicator. The table lists many of the common indicators, their ranges of pH and colour change, and pK values.

Table-1: Common-acid base indicators

Common name	pH range	Colour change (acid to base)	pK
Methyl violet	0–2, 5–6	Yellow to blue violet to violet	2.3
Metacresol purple	1.2–2.8, 7.3–9.0	Red to yellow to purple	1.5
Thymol blue	1.2–2.8, 8.0–9.6	Red to yellow to blue	1.7
Tropeoline (Orange IV)	1.4–3.0	Red to yellow	2.1
Bromphenol blue	3.0–4.6	Yellow to blue	4.1
Methyl orange	2.8–4.0	Orange to yellow	3.4
Bromcresol green	3.8–5.4	Yellow to blue	4.9
Methyl red	4.2–6.3	Red to yellow	5.0
Chlorphenol red	5.0–6.8	Yellow to red	6.2
Bromocresol purple	5.2–6.8	Yellow to purple	6.4
Bromothymol blue	6.0–7.6	Yellow to blue	7.3
Phenol red	6.8–8.4	Yellow to red	8.0
Cresol red	2.0–3.0, 7.2–8.8	Orange to amber to red	8.3
Orthocresolphthalein	8.2–9.8	Colourless to red	8.9
Phenolphthalein	8.4–10.0	Colourless to pink	9.7
Thymolphthalein	10.0–11.0	Colourless to red	9.9
Alizarin yellow GG	10.0–12.0	Yellow to lilac	11.2
Malachite green	11.4–13.0	Green to colourless	12.4

The plant *Tagetes erecta* locally known as Marigold belongs to the family Asteraceae (Compositae). It is a stout, branching herb, native of Mexico and other warmer parts of America and naturalized elsewhere in the tropics and subtropics including Bangladesh and India. It is very popular as a garden plant and yields a strongly aromatic essential oil (tagetes oil), which is mainly used for the compounding of high-grade perfumes. Different parts of this plant including flowers are used in folk medicine to cure various diseases. Leaves are used as antiseptic and in kidney troubles, muscular pain, piles and applied to boils and carbuncles. The flowers are used as antibacterial, antimicrobial, mosquitocidal, hepatoprotective, insecticide, anti-oxidants and analgesic [1-10] and are also employed in diseases of the eyes. They are said to purify blood and flower juice is given as a remedy for bleeding piles and also used in rheumatism, colds and bronchitis. Phytochemical studies of its different parts have resulted in the isolation of various chemical constituents such as thiophenes, flavonoids, carotenoids and triterpenoids. The plant *Tagetes erecta* has been

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shown to contain quercetagetin, a glucoside of quercetagetin, phenolics, syringic acid, methyl-3,5-dihydroxy-4-methoxy benzoate, quercetin, thienyl and ethyl gallate.

2. MATERIALS AND METHODS

2.1 *Plant material*

Fresh flowers of *Tagetes erecta* were collected from the medicinal gardern Anurag Pharmacy College during November 2011 and identified taxonomically in Dept of Pharmacognosy, Anurag Pharmacy College, Kodad, Andhra Pradesh, India. 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 and 1 part of dilute hydrochloric acid for 3 hrs. The extract was preserved in tightly closed container and stored away from the direct sun light. Analytical grade reagents were made available by Anurag Pharmacy College. Reagents and volumetric solutions were prepared as per Indian Pharmacopeia.

The experiment was carried out by using a same set of glass wares for all types of titrations. The reagents were not calibrated: as same aliquots were used for both titrations i.e. titration by using standard indicator and fruit extract.

5 ml of titrant and 3 drops of indicator was titrated. Each titration was carried five times and results were recorded. Mean and standard deviations were calculated from the results. The Methanolic extract of fresh flowers of *Tagetes erecta* was screened for its use as indicator for Acid-Base titration and the results of this screening were compared with the results obtained by using standard indicators.

3. RESULTS AND DISCUSSION

The flowers was screened for its use as an indicator in acid base titration and the results were compared with the results obtained by standard indicators methyl red, phenolphthalein. The results of the screening for strong acid-strong base (HCl & NaOH), strong acid -weak base (HCl & NH3), weak acid-strong base (CH3COOH & NaOH) and weak acid-weak base (CH3COOH & NH3) are listed in Table-2.

Table-2: Parameters for titration

Titrant	Titrand	Indicator colour change and (Ph range)	
		Standard	Flower Extract
HCl	NaOH	Colorless to pink (PH)	Pink to colourless
HCl	NH3	HCl Red to yellow (MR)	Pink to colourless
CH3COOH	NaOH	NaOH Colorless to pink (PH)	Pink to colourless
CH3COOH	NH3	CH3COOH NH3 Yellow to red (PR)	Pink to colourless

Key: PH=Phenolphthalein, MR= Methyl Red PR=Phenol Red

The screening was carried out using three different molar strength of acids and alkalis viz. 0.1, 0.5, 1.0 M. For all types of titrations equivalence point obtained by the flower extract either exactly or very closed with the equivalence point obtained by the standard indicators are shown in table-3. This represents the usefulness of flower extract as an indicator in acid base titration .Its use in weak acid and weak base was found to be more significant over standard indicator as it gives sharp colour change in a narrow pH range. The results obtained showed that the routinely used indicator can be replaced successfully by flower extracts.

Table-3: Mean volume (in ml) at the equivalence point for titrations

Strength (in M)	Hydrochloric acid v/s Sodium Hydroxide		Hydrochloric acid v/s Ammonia		Acetic acid v/s Sodium Hydroxide		Acetic acid v/s Ammonia	
	PH	FE	PH	FE	PH	FE	PR	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
0.1	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

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

Thus natural indicator employed in the acid base titrations was found economic, safe and an efficient alternative for traditional indicators. In comparison to this, chemical indicators were found more expensive and hazardous, which proves that flower extract of *Tagetes erecta* as a natural indicator is more worthy.

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