International Journal of Chemical Science
Online ISSN: 2523-2843, Print ISSN: 2523-6075
Impact Factor: RJIF 5.22
www.chemicaljournals.com
Volume 2; Issue 4; July 2018; Page No. 16-19

Ethanolic extracts of *Telfairia occidentalis* and A*belmoschus esculentus* flowers as substitutes to hazardous synthetic indicators in acid - base titration

Abuh LO[1], Akor JA[2], Abdullahi Y[3], Egu SA[4*]
[1, 2, 3] Department of Integrated Science, College of Education, Ankpa, Kogi, Nigeria
[4] Department of Chemistry, College of Education, Ankpa, Kogi, Nigeria

Abstract
This work has expanded the list of natural plants (flowers) as workable substitutes to synthetic indicators in acid-base titration. The ethanolic extract of the flowers of *Telfairia occendentalis* and *Abelmoschus esculentus* showed the plants to have great potentials as indicators in acid-base titrimetric analysis because the extracts produced workable results in all the titrations conducted. *Tefairia occidentalis* displayed closer characteristics to phenolphthalein in weak acid – strong base and weak acid – weak base titrations and *Abelmoschus esculentus* with methyl orange in strong acid – strong base titration; all with values within limits. However, these plants provided workable and sustainable substitutes to the expensive, hazardous, non-eco-friendly synthetic indicators.

Keywords: indicators, *Telfiaria occidentalis*, *Abelmoschus esculentus*, extracts

1. Introduction

Many substances, natural or synthetic display colours that depend on the solution of the pH in which they are dissolved, some have been used for centuries to indicate the acidity and alkalinity of water and are still employed as acid-base indicators.

Many natural plants contain coloured anthocynin compound that are red in acidic solution and blue in basic solution. Dye extracted from plants are natural substances commonly used as acid-base indicator.

Nerium oleander flower was used in strong acid-strong base titration and was found to be significant over standard indicator as it gives sharp colour change at equivalent point that as result obtained from routinely used indicators. Reference [1] found that this could be replaced successfully by flower extract as they are simple, accurate, economical and precise and can be prepared just before experiment.

Reference [2] conducted an investigation on white and red frangipani which showed that some natural plants are known to be less harmful to human, animals and the ecosystem and hence advised the return to natural indicators. Their findings showed a cheap and fast workable substitute to methyl orange and phenolphthalein in strong acid-base titration and strong acid/weak base titration and recommend that the flower extract of red and white frangipanis be used as indicator in acid-base titration as substitutes to hazardous synthetic indicator.

Synthetic indicators today are the choice of indicators in acid-base titration. These indicators - methyl orange, phenolphthalein, methyl red etc. - have been discovered to possess environmental treats i.e. pollution and health hazard to human, animals and plants. Methyl orange may cause gastrointestinal irritation with nausea, vomiting and diarrhea if swallowed. Reference [3] reported that it contains an anionic dye and so may cause eye irritation. Reference [4] discovered that methyl red also shows potential health effects like eye irritation, skin irritation; may be harmful if absorbed through the skin, may cause irritation of the digestive tract if swallowed and may also cause respiratory tracts irritation if inhaled; Phenolphthalein may cause eye irritation, skin irritation, gastro intestinal irritation with nausea, vomiting and diarrhea, respiratory tract irritation & may cause kidney injury. These effects of synthetic indicators have raised scientific concerns over the years & have led to proffering solution to the avoidance of the use of these indicators to a less harmful and environmentally friendly ones.

The use of natural indicators have proven to produce same result with the synthetic ones thereby competing favourably to serve as substitutes to some of these synthetic indicators. A dye is a coloured substance that has affinity to a substrate to which it is applied: the greater source of dyes has been from the plant kingdom, notably roots, berries, bark, leaves, flowers and wood, [5] and [6].

Co-authors [7] asserted that floral extracts of *Euphobia Mili*, *Erythrina Varigata* & *Nelumbo nucifera* have been selected to solve pollution problem of synthetic indicators; they also mentioned that the use of natural indicator is more beneficial to the economy, ease of preparation, simplicity, ease of availability, eco-friendly inert & accurate result. References [8] and [9] mentioned that environmental pollution must be reduced by the use of natural products instead of chemicals to minimize pollution. Reference [10] reported titrimetric analysis conducted on *B. alba* indicating that it showed a valuable result that can be a suitable indicator in all tirimetric analysis except weak acid/weak base. Reference [11], from green chemistry view point recommended the use of *Allium cepa* in routine acid-base titration as they found it to be inexpensive and acts reversibly to impart sharp colour change at equivalence point. Reference [12] advised that natural indicators should be exploited to prevent toxicity among users

and pollution of the environment. They finally asserted that standard indicators can be successfully substituted with Waa kye leave they studied as indicator for simple acid-base titration.

Reference [13] reported that *Telfairia occidentalis* (*T. occidentalis*) is a tropical vine grown in West Africa as a leaf vegetable and for its edible seeds. Common name for the plant include fluted gourd, fluted pumpkin and Ugu in the Igbo language in Nigeria. *T.occidentalis* is a member of the kingdom plantae, order, Cucurbitales family, indigenous to southern Nigeria. Author [14] reported that the fluted gourd grows in many nations of West Africa but is mainly cultivated in Igbo land, south eastern Nigeria and used primarily in soup and herbal medicine. The fluted gourd fruit is quite large; slidely documented 6.3 – 41.3 or 16 -105 cm in length & an average of 9 cm in diameter. *T.occidentalis* flowers grow in set of five, with creamy-white and red petals contrasting with light green colour of the fruits when young and yellow when ripe.

Reference [15] found that *Hibiscus esculentus* also called okro (okra) is a multilarginous seed pod (fruit) used as vegetable in India and Africa. Botanically it is *Abelschus esculentus* and belongs to Malvaceae (mallows) family. The unripe seed pods (fruits) contain mucilage substance which is beneficial for increasing muscular strength & improving skin health. It is a perennial flowering plant that grows to 1 – 2 meter in height, with leaves 10 – 20 cm long having 5 -7 palmate lobes and broad in shape. The flower is 4 – 8 cm in diameter with 5 light yellow petals.

Synthetic indicator has been in use over the years and are still fervently in use in schools, Colleges and even in the Universities. The hazardous nature of these indicators like irritation to eye and skin and diarrhea, etc has raised a lot of concern in recent time amongst scientists; researchers have set the ball in recent time to find probable substitutes to these hazardous indicators (methyl orange, methyl red, phenolphthalin, etc). This search has called for the use of natural plants as they are found to be less hazardous, readily available and a most of all environmentally friendly. In view of this, the researchers intend to expand the list of dye bearing natural plants by exploring the flowers of *Telfaria occidentalis* and *Abelmelmoscus esculentus* substitute as indicator to hazardous indicator in acid-base titration.

The objective of this work is to extract dyes from the flowers of *Telfaria occidentalis* and *Abelmelmocus esculentus* to be used as indicator in acid-base titration so as to expand the list of natural plants that can serve as purposeful substitute to hazardous synthetic indicators.

2. Materials and method

The flower of *T. occidentalis* and *H. esculentus* were freshly collected and rinsed in distilled water, separated and placed in mortar and crushed with a pestle, the crushed flower were placed in a 250 ml beaker and 150 ml and absolute ethanol was added. The mixture was covered properly with an aluminum foil paper to prevent evaporation of the alcohol from the beaker. Mixture was allowed to stand for 24 hrs for effective extraction. The extracts were filtered and the filtrate was carefully decanted into a glass bottle and was properly covered and kept away from sunlight to be used as natural indicator. Analytical grade methyl orange, phenolphthalein, sodium hydroxide, ethanoic acid, hydrochloric acid and sodium trioxocarbonate were used, obtained from the integrated science department of Kogi State College of Education, Ankpa. Standard analytical procedure was employed in the preparation of the reagents. 0.1 M was prepared for all the acid and the base. Titrimetric analysis was conducted for strong acid – strong base, strong acid – weak base, weak acid – strong base and weak acid – weak base.

25 ml each of the base was measured into the conical flask; two drops of the synthetic indicators (methyl orange and phenolphthalein) were used for each titration and 1 ml of the *T. occidentalis* and *Hibiscus esculentus* were used as natural indicators. A set of three (3) titrations were conducted for each of the indicator taking note of the equivalents point after which the average volume of the acid used for the indicators were calculated. This procedure was conducted for HCl/NaOH, HCl/Na_2CO_3, CH_3COOH/NaOH, CH_3 COOH /Na_2CO_3.

3. Results and discussion

Table 1: Colour change of the indicators

Indicators	In acid	In base	At end point
MO	Pink	Orange	Pink
Phe	Colourles	Purple	Colourless
TO	Pink	Green	Pink
HE	Colourless	Lemon-green	Colourless

MO = Methyl orange; Phe = Phenolphthalein; TO = *Telfaria occidentalis*; HE = *Hibiscus esculentus*

Table 2: Titrimetric results

Indicators	Average titre values (mL)			
	SA/SB (HCl/ NaOH)	SA/WB (HCl/Na2CO3)	WA/SB (CH_3COOH/ NaOH)	WA/WB (CH_3COOH/Na_2CO_3)
MO	8.90	16.40	24.60	33.20
Phe	8.20	8.10	4.80	4.80
TO	7.20	11.90	4.90	4.90
HE	8.80	20.10	9.10	11.20

Titre value is the volume of acid used; SA/SB = strong acid/strong base; SA/WB = strong acid/weak base; WA/SB = weak acid/strong base; WA/WB = weak acid/weak base

The flower of the plants in acid, base and at end point showed pink, green, & pink colours respectively for *Telfairia occidentalis* and colourless, lemon green and colourless respectively for *Hibiscus esculentus* (Table 1). The end point for both plants was sharp.

The average volumes of acids used in titration of HCl/NaOH for methyl orange, phenolphthalein *Telfairia occidentalis* and *Hibiscus esculentus* are 8.90 cm^3, 8.20 cm^3, 7.20 cm^3 and 8.80 cm^3 respectively (Table 2) with methyl orange and *Hibiscus esculentus* having value of concordance which suggest the plants a good substitute to methyl orange.

The average volume of acid used for methyl orange is 16.40 cm^3, phenolphthalein 8.10 cm^3, *Telfairia occidentalis* 11.90 cm^3 and *Hibiscus esculentus* 20.10 cm^3. Values were not close enough to serve as concordance substitutes but presented a workable results that shows the potency of the plants as

indicators in acid-base titration. (Table 2)

The titrimetric reaction of CH_3COOH and NaOH showed average volume of acid used for methyl orange to be 24.60 cm^3, phenolphthalein 4.80 cm^3, *Telfairia occidentalis* 4.90 cm^3, *Hibiscus esculentus* as 9.10 cm^3. *Telfairia occidentalis* exhibited better replacement for phenolphthalein; however, *Hibiscus esculentus* showed potentials of a good substitute to phenolphthalein. (Table 2)

Titrimetric result of weak acid/weak base showed suitable concordance between phenolphthalein and *Telfairia occidentalis* with average volume of acid of 4.80 cm^3 and 4.90 cm^3 respectively showing the plants to substitute best for phenolphthalein. *Hibiscus esculentus* displayed a good workable value of 11.20 cm^3 & could also serve as a substitute to phenolphthalein in the absence of *Telfiaria occidentalis*. None of the plants value were close to the methyl orange with average value of 33.20 cm^3, however it presented a workable (Table 2).

The titrimetric result presented showed *Telfairia occidentalis* to be a better workable substitute to phenolphthalein, in HCl/NaOH & CH_3COO/Na_2CO_3. Reference [16] carried out a research that is in agreement with our findings; their findings showed ginger (a natural plant) to substitute better for phenolphthalein in strong acid/strong base and weak acid/weak base.

Reference [7] also disclosed in their findings that extracts of *Euphonia mil*, *Enthrina marigata* & *Melumbo nucifera* have a very close equivalence point to standard indicators & they emphasized the usefulness of alcoholic extract as an indicator in acid-base titrations. They further recommend the usage of this flowers in acid titration as they are simple and widely available. Authors [17], in their findings on *Bougainvilla glabra* – a natural indicator, reported that the can be used as acid – base indicator in titration of strong acid with strong base, they also recommend the use of *Bougainvilla glabra* juice in preference to phenolphthalein because of its ease of availability, inertness, preparation and low cost effectiveness.

4. Conclusion

The quest and strive of researchers to find possible solution or substitute to synthetic dye have become pertinent in that the effects on the user and the ecosystem has generated great concern, this has increased the search into natural plants as they are environmentally compatible, biodegradable, easily available at lower or no cost. A total switch to the use of natural plants will salvage our environment a great deal and will reduce health hazard on users frequently disposed to the utilization of synthetic dye.

The results obtained from this research have shown that the plants have excellent potentials to serve as substitutes to the synthetic indicators, with *Hibiscus esculentus* presenting better substitute to methyl orange in strong acid/strong base analysis and *Telfairia occidentalis* acting a better substitute to phenolphthalein in the remaining analyses. These plants are easily sourced, cheap, and environmentally friendly.

5. Recommendations

Our findings showed these plants to exhibit good acid-base indicator potency with high workability that brings accurate results. The indicators studied are actively potent for three months and can even stays longer if refrigerated. However, freshly prepared indicators have always been used for titrations.

We therefore recommend the use of *Telfairia occidentalis* and *Hibiscus esculentus* flowers as indicators in acid-base titration.

We also recommend that teachers in schools and colleges should explore their environment to put into effective use natural plants in similar or even other applications so as to expand the use of nature and having replacement to synthetic dyes and other chemicals.

Schools, colleges, universities and research institutions should encourage research of this kind by giving grants to make the research worthwhile as researchers will be encouraged to even break up the slope further for better results or findings.

6. References

1. Sarita K, Adhikrao Y, Vijay R, Karishma W. Comparative study of natural and synthetic indicators. Der pharma chemical. 2013; 5(1):296-299.
2. Abuh LO, Egu SA, Isah AA. Extraction and utilization of natural products (*Plumeria species*) grown in Ankpa, Kogi State Nigeria. An environmentally friendly source of acid – base indicator for titrimetric analysis. Journal of Basic and Applied Research International. 2016; 18(1):49-52.
3. MSDS. methyl orange 1-3. Available at, 2006, https://www.proscitech.com>edu.msds. Retrieved 5/5/17
4. MSDS. Potential health effect of methyl red, 2008, 1-4. Available at https://ch.ntu.edu>msds>exp3. Retrieved 5/5/17.
5. Balter M. Clothes make the man. Hefman publisher. London, 2009.
6. Kvavadze E, Ofer B, Anna B, Elizabeth B, Nino J, Zinovi M, Tengiz M. 30,000 years old flax fibres. Creation book publisher, Georgia, 2009.
7. Shivaji, H.B. and Ankush, V.M. Natural indicators as a eco-friendly acid-base titration. Journal of chemical and pharmaceutical research. (2014); 6(5):901-903.
8. Sultan ME, Sirry SM. Usefulness of some plants flowers as natural acid –base indicators. Journal of chinese chemical society. 2002; 49(1):63-68.
9. Okoli BE, Mgbeogu CM. Fluted pumpkin,Telfairia occidentalis: west African vegetable crop school of Biological science, University of Portharcourt. Springer. 1983; 32(2):145-149.
10. Izonfuo WA, Fekarurhobo GK, Obomanu FG, Daworiye LT. Acid-base indicators properties of dye from plants. Dye from Basella alba (Indian Spinach) and Hibiscus Sabdarttaq (zobo). Journal of applied science and environmental management. 2006; 10(1):5-8.
11. Yogini B, Neena A, Chirag G, Umesh V. Green alternative to synthetic indicators in acid-base titration. Journal of chemical and environmental science. 2015; 3(6):64-65.
12. Daniel AA, Ochene BA, Gregory P. Investigation of simple and cheap source of a natural indicator for acid-base titration. Effect of system conditions on natural indicator. Green and sustainable chemistry. 2012; 2:117-122.

13. Akoroda MO. Ethobothany of *Telairia occidentalis* (curcurbitcaea) among Igbos of Nigeria. *Economy Botany*. 1990; 44(1):29-39.
14. Nwanna EE. Antioxidant & Hepatoprotective properties of Telfairia occidentalis leave (fluted pumpkin). Available, 2008, at httpd://dspace.futa.edu.ng:8080/ Jspul/ handle/123456789/587> Retrieved 02/09/2017.
15. Jagdev S. Abelmoschus (Hibiscus) esculentus, okra (bhindi) benefits. Available at, 2015, https://www.a yutimes.com>abelmoschus. Retrieved 7/5/17.
16. Uche I, Uju AA, Godson I. Extraction and workability of some local plants dye as acid-based indicaton. International Journal of research in applied natural and social sciences. 2014; 2(7):1-6.
17. Pokhama G, Jam NK, Nalwaya N, Prin KMK. Bougainvilla glabra – A natural indicator. Available at, 2013, www.reachgate.net. Retrieved.