IJP (2017), Vol. 4, Issue 2 **(Review Article)**

Received on 01 December 2016; received in revised form, 23 December 2016; accepted, 26 December 2016; published 01 February 2017

A COMPREHENSIVE REVIEW ON PLANT EXTRACT AS AN HERBAL INDICATOR IN TITRIMETRIC ANALYSIS

Sarika S. Jadhav, Varsha B. Khillari, and Sachin V. Tembhurne *

Sudhakarrao Naik Institute of Pharmacy, Nagpur Road, Pusad - 445215, Maharashtra, India.

Keywords:

Herbal extract,
Synthetic indicator,
Herbal indicator, Titrimetric analysis

Correspondence to Author:
Sachin V. Tembhurne

Head,
Department of Pharmacology,
AISSMS College of Pharmacy,
Pune - 411001, Maharashtra, India.

E-mail: stembhurne@gmail.com

ABSTRACT: The synthetic indicators are used in acid-base titration for determination of endpoint. A part of its application, the synthetic indicators has several limitations such as toxic, costly, corrosive, *etc*. Thus, herbal indicators are the choice of today for acid-base titrations. The 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 a sharp color change at the equivalence point. The equivalence points obtained from the various part of the plant coincide with the equivalence points obtained by the standard indicators. These natural indicators are found to be very useful, economical, accurate and straightforward for the said titration. In this review, we mentioned the importance of some herbal indicators as per their finding reported by the earlier researcher.

INTRODUCTION: Indicator solution is a substance that has a different color on acid, alkaline, and neutral. As a result, the solution can be used to distinguish acid, alkaline, and neutral. Some of the indicators commonly used in laboratories, among other phenolphthalein solution (pp), red metal and orange metal [1]. The term titrimetric analysis refers to quantitative chemical analysis carried out by determining the volume of a solution of accurately known concentration which is required to react quantitatively with a measured volume of a solution of the substance to be determined. 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.

QUICK RESPONSE CODE

DOI:

10.13040/IJPSR.0975-8232.IJP.4(2).54-59

The article can be accessed online on
www.ijpjournal.com

DOI link: http://dx.doi.org/10.13040/IJPSR.0975-8232.IJP.4(2).54-59

This is because the solution of these materials gives 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 extracts 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. 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 ‘endpoint or the ‘equivalence point. The indicator is a substance which exhibits a color change at a particular stage of the chemical reaction.

Almost any flower, for example, that is red, blue, or purple, 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 Colours. Indeed, Boyle made an essential contribution to the early theory of acids and bases by using indicators for the experimental classification of these substances [2, 3].

***Hibiscus rosa-sinensis*:** *Hibiscus rosa-sinensis* (HRS) from family Malvaceae gives sharp and intense color change as phenolphthalein and methyl orange. Herbal indicator property of HRS is evaluated by using strong acid-strong base, a strong acid-weak base, weak acid-strong base, and weak acid-weak base. In strong acid *vs.* strong base type of titration HRS showed endpoint observation orange to green at 20.00 ml of titrant quantity while the synthetic methyl red indicator indicated pink to the yellow color end point at 22.2 ml.

In strong acid *vs.* weak base type of titration HRS showed end point observation orange to green at 2.7 ml titrant volume while the synthetic methyl red indicator indicated pink to the yellow color end point at 4.5 ml. In weak acid *vs.* strong base type of titration HRS showed endpoint observation pink to colorless at 7.7 ml of titrant volume while the synthetic methyl red indicator indicated red to the orange color end point at 31.4 ml. In weak acid *vs.* weak base type of titration HRS showed endpoint observation pink to colorless at 1.5 ml of titrant volume while the synthetic methyl red indicator indicated pink to the yellow color end point at 3.5 ml. In all these titrations the extract of HRS was found to be very useful and accurate for indicating the equivalence point (neutralization point) indicates indicator property [4].

***Catharanthus roseus*:** *Catharanthus roseus* Family Rosaceae gives sharp and intense color change as compared to phenolphthalein and methyl orange. Herbal indicators are evaluated by using strong acid-strong base, a strong acid-weak base, weak acid-strong base, and weak acid-weak base. In strong acid *vs.* strong base type of titration, CRS showed endpoint observation orange to colorless at 8.0 ml of titrant volume while the synthetic methyl orange indicator indicated orange to the pink color end point at 23.6 ml.

In strong acid *vs.* weak base type of titration CRS showed endpoint observation orange to green at 3.5 ml of titrant volume while the synthetic methyl orange indicator indicated orange to pink color end point at 4.1 ml in weak acid *vs.* strong base type of titration CRS showed endpoint observation pink to colorless at 4.5 ml of titrant volume while the synthetic methyl orange indicator indicated yellow to red color end point at 31.8 ml. In weak acid *vs.* weak base type of titration, CRS showed endpoint observation pink to colorless at 0.9 ml of titrant volume while the synthetic methyl orange indicator indicated orange to the pink color end point at 4.6 ml. In all these titrations the extract was found to be very useful and accurate for indicating the equivalence point (neutralization point) indicates indicator property. In all these titrations the extract was found to be very useful and accurate for indicating the equivalence point [4].

***Nerium oleander* Linn.:** *Nerium oleander* L. (Apocynaceae) is evergreen, glabrous shrub up to 6 m high, native of the Mediterranean region and extending as far as Iran. It is often grown in Indian gardens for ornament and also as a fence and a windbreak. It is most commonly known as oleander, from its superficial resemblance to the unrelated olive Olea, but has many other names. In strong acid *vs.* strong base type of titration extract of *Nerium oleander* (ENO) showed endpoint observation orange to colorless at 7.0 ml volume of titrant while the synthetic Phenolphthalein indicator indicated colorless to the pink color end point at 24.5 ml.

In strong acid *vs.* weak base type of titration, ENO showed endpoint observation orange to colorless at 1.9 ml volume of titrant while the synthetic Phenolphthalein indicator indicated colorless to the pink color end point at 3.9 ml. In weak acid *vs.* strong base type of titration, ENO showed endpoint observation pink to colorless at 3.2 ml volume of titrant while the synthetic Phenolphthalein indicator indicated colorless to the pink color end point at 31.1 ml. In weak acid *vs.* weak base type of titration, ENO showed endpoint observation pink to colorless at 0.8 ml volume of titrant while the synthetic Phenolphthalein indicator indicated colorless to the pink color end point at 4.1 ml.

In all these titrations the extract was found to be very useful and accurate for indicating the equivalence point (neutralization point) indicates indicator property. The above-reported results

indicates the use of *Nerium oleander* Las Universal indicator as it shows the close endpoint as well as color change as compared with respective synthetic indicator [4].

***Hibiscus sabdariffa*:** *Hibiscus sabdariffa* (HSCA) commonly known as Red tea and belonging to family Malvaceae, is used in the tropics as emollient, purgative, sedative, stomachic, digestive, demulcent, tonic and aphrodisiac. Documented some compounds that have been isolated and characterized from *Hibiscus sabdariffa*, which included flavonoids, anthocyanidins, triterpenoids, steroids, alkaloids, sesquiterpenes, quinines, and naphthalenes.

Titre values of various acid-base and complexometric titrations involving standard indicator and HSCA indicators end-point. In strong acid *vs.* strong base type of titration HSCA showed endpoint observation at 14.47 ml volume of titrant while the standard synthetic indicator indicated endpoint at 16.15 ml. In strong acid *vs.* weak base type of titration HSCA showed endpoint observation at 10.33 ml volume of titrant while the Standard synthetic indicator indicated endpoint at 16.15 ml. In weak acid *vs.* strong base type of titration HSCA showed endpoint observation at 18.47 ml volume of titrant while the Standard synthetic indicator indicated endpoint at 19.23 ml.

In weak acid *vs.* weak base type of titration HSCA showed endpoint observation 8.33 ml volume of titrant while the Standard synthetic indicator indicated endpoint at 8.57 ml. In Na2EDTA *vs.* tap water type of titration, HSCA showed endpoint observation at 9.33 ml volume of titrant while the standard synthetic indicator indicated endpoint at 9.33 ml in all these titrations the extract was found to be very useful and accurate for indicating the equivalence point (neutralization point) indicates indicator property. The above-reported results indicate the use of *Hibiscus sabdariffa* as a universal indicator as it shows the close endpoint as well as color change as compared with respective synthetic indicator [5].

***Punica granatum* Linn.:** The fruits of *Punica granatum* L. (Punicaceae) are commonly eaten. Phytochemical the plant has been attributed to contain punicalagin, penicillin, strictinin andgranatin. It also contains flavonoids, anti-oxidants, and anthocyanins as well. The herbal indicator property of fruit extract of *Punica granatum* (FEPG) has been evaluated by titrimetric analysis. In strong acid *vs.* strong base type of titration, FEPG showed endpoint observation pink to colorless at 7.7 ml volume of titrant while the synthetic phenolphthalein indicator indicated colorless to the pink color end point at 7.8 ml.

In strong acid *vs.* weak base type of titration, FEPG showed endpoint observation pink to colorless at 7.5 ml volume of titrant while the synthetic methyl red indicator indicated red to the yellow color end point at 7.4 ml. In weak acid *vs.* strong base type of titration, FEPG showed endpoint observation pink to colorless at 7.8 ml volume of titrant while the synthetic phenolphthalein indicator indicated colorless to the pink color end point at 7.9 ml. In weak acid *vs.* weak base type of titration, FEPG showed endpoint observation pink to colorless at 9.1 ml volume of titrant while the synthetic Phenol red indicator indicated yellow to red color end point at 9.12 ml. In all these titrations the extract was found to be very useful and accurate for indicating the equivalence point (neutralization point) indicates indicator property [6].

***Antirrhinum majus*:** *Antirrhinum majus* belonging to the family Scrophulariaceae and is commonly known as a dog-flower in India and snapdragon other places. In the literature for the evaluation of herbal indicator property of plant extract of *Antirrhium mag*us (AM) titrimetric analysis was performed. In strong acid *vs.* strong base type of titration AM showed endpoint observation pink at 10.2 ml volume of titrant while the synthetic Phenolphthalein indicator indicated pink color end point at 10.5 ml.

In strong acid *vs.* weak base type of titration AM. Showed endpoint observation pink at 9.5 ml volume of titrant while the synthetic phenolphthalein indicator indicated pink color end point at 10 ml. In weak acid *vs.* strong base type of titration AM showed endpoint observation pink at 9.7 ml volume of titrant while the synthetic Phenolphthalein indicator indicated pink color end point at 9.5 ml. In weak acid *vs.* weak base type of titration AM showed endpoint observation pink at 9.7 ml volume of titrant while the synthetic

Phenolphthalein indicator indicated pink color end point at 9.5 ml. In all these titrations the extract was found to be very useful and accurate for indicating the equivalence point (neutralization point) indicates indicator property. The above-reported results indicate the use of *Antirrhinum majus* as the universal indicator as it shows the close endpoint as well as color change as compared with respective synthetic indicator [7].

***Dianthus pulmarius*:** *Dianthus pulmarius* belonging to the family Caryophyllaceae, common names include gardens, pink, wild pink native mainly to Europe and Asia. In the literature for the evaluation of herbal indicator property of fruit extract of *Dianthus pulmarius* (FEDP), titrimetric analysis was performed. In strong acid *vs.* strong base type of titration FEDP showed endpoint observation violet color at 10.4 ml volume of titrant while the synthetic phenolphthalein indicator indicated violet color end point at 10.5 ml.

In strong acid *vs.* weak base type of titration FEDP showed endpoint observation violet at 10.2 ml volume of titrant while the synthetic phenolphthalein indicator indicated violet color end point at 10 ml. In weak acid *vs.* strong base type of titration FEDP showed endpoint observation violet at 9.5 ml volume of titrant while the synthetic Phenolphthalein indicator indicated violet color end point at 9.5 ml. In weak acid *vs.* weak base type of titration FEDP showed endpoint observation violet color at 9.4 ml volume of titrant while the synthetic Phenolphthalein indicator indicated violet color end point at 9.5 ml.

In all these titrations the extract was found to be very useful and accurate for indicating the equivalence point (neutralization point) indicates indicator property. The above-reported results indicate the use of *Dianthus pulmarius* as the universal indicator as it shows the close endpoint as well as color change as compared with respective synthetic indicator [7].

***Morus alba*:** *Morus alba* Linn. belonging to the family Moraceae (Urticaceae); it is commonly called as white Mulberry; toola; tuk; shetu. It is a found wild on the temperate Himalayas and cultivated in Kashmir, Punjab, and Maharashtra near Mahabaleshwar. Chemical constituents of fruits are anthocyanins, anthraquinones, glycosides, and oleanolic acid. Evaluation of herbal indicator property of fruit extract of *Morus alba* (FEMA) titrimetric analysis was performed. In strong acid *vs.* strong base type of titration, FEMA showed endpoint observation blue to pink in range of 5.5 to 8.5 ml volume of various molar concentration titrant while the synthetic phenolphthalein indicator indicated pink to the colourless clear end point at a range of 8.2 to 10.0 ml.

In strong acid *vs.* weak base type of titration, FEMA showed endpoint observation blue to pink in the range of 5.5 to 8.5 ml volume of various molar concentration titrant while the synthetic Phenolphthalein indicator indicated pink to the colourless clear end point at a range of 8.2-10.0 ml. In weak acid *vs.* strong base type of titration, FEMA showed endpoint observation blue to pink in the range of 5.5 to 8.5 ml volume of various molar concentration titrant while the synthetic methyl red indicator indicated yellow to the pink color end point at 4.2 to 6.3 ml. In weak acid *vs.* weak base type of titration, FEMA showed endpoint observation blue to pink in the range of 5.5 to 8.5 ml volume of various molar concentration titrant while the synthetic Phenolphthalein indicator indicated pink to the colourless clear end point at 8.2 to 10.0 ml.

In all these titrations the extract was found to be very useful and accurate for indicating the equivalence point (neutralization point) indicates indicator property. The above-reported results indicate the use of FEMA as a universal indicator as it shows the close endpoint as well as color change as compared with respective synthetic indicator [8].

***Calendula officinalis*:** *Calendula officinalis* is commonly known as marigold related to family Compositae. It is an aromatic, seldom biennial. In the literature flower extract of *Calendula officinalis* (CO) has indicator property. In strong acid *vs.* strong base type of titration CO showed endpoint observation colourless to yellow near to 10.7 ml volume of titrant while the synthetic methyl red indicator indicated red to yellow color end point near to 10.5 ml volume of titrant. In strong acid *vs.* weak base type of titration, CO showed endpoint observation yellow to colorless near to 3.8 ml

volume of titrant while the synthetic methyl orange indicator indicated yellow to red color end point near to 3.7 ml.

In weak acid *vs.* strong base type of titration, CO showed endpoint observation colourless to yellow near to 9.9 ml volume of titrant while the synthetic Phenolphthalein indicator indicated colorless to the pink color end point at 10.7 ml. In weak acid *vs.* weak base type of titration, CO showed endpoint observation colorless to yellow near to 19.4 ml volume of titrant while the synthetic mixed indicator indicated orange to blue color end point near to 6.4 ml. In all these titrations the extract was found to be very useful and accurate for indicating the equivalence point (neutralization point) indicates indicator property. The above-reported results indicate the use of *Calendula officinalis* flower extract as a universal indicator as it shows the close endpoint as well as color change as compared with respective synthetic indicator [9].

***Butea monosperma*:** *Butea monosperma* (Lam.) is commonly known as Flame of forest belongs to the family Fabaceae. It is locally called as palas, Palash, dhak and is common throughout India. In the literature flower extract of *Butea monosperma* (FEBM) indicated indicator property. In strong acid *vs.* strong base type of titration FEBM showed endpoint observation Colourless to yellow near to 10.8 ml volume of titrant while the synthetic methyl red indicator indicated red to yellow color end point near to 10.5 ml. In strong acid *vs.* weak base type of titration, FEBM showed endpoint observation yellow to colorless near to 3.8 ml volume of titrant while the synthetic methyl orange indicator indicated yellow to red color end point near to 3.7 ml. In weak acid *vs.* strong base type of titration, FEBM showed endpoint observation colorless to yellow near to 10.8 ml volume of titrant while the synthetic phenolphthalein indicator indicated colorless to pink color end point near to 10.7 ml.

In weak acid *vs.* weak base type of titration, FEBM showed endpoint observation colorless to yellow near to 18.7 ml volume of titrant while the synthetic mixed indicator indicated orange to blue color end point near to 6.4ml. In all these titrations the extract was found to be very useful and accurate for indicating the equivalence point (neutralization point) indicates indicator property. The above-reported results indicate the use of *Butea monosperma* flower extract as the universal indicator as it shows the close endpoint as well as color change as compared with respective synthetic indicator [9, 10].

***Boerhavia erecta* Linn.:** *Boerhavia erecta* Linn. found all over India belonging to family Nyctaginaceae. It is commonly called as Shwet Punarnava and used as a substitute to *Boerhavia diffusa* (Punarnava). The plant contains tannins which are pH sensitive; it was hypothesized that the stem extract of *Boerhavia erecta* (SEBE) could be utilized as an indicator for different types of acid-base titrations. The reported literature indicated that in the titration of strong acid *vs.* strong base type SEBE showed endpoint observation yellow to pink near to 16.00 ml volume of titrant while the synthetic methyl red indicator indicated yellow to pink color end point near to 16.00 ml. In strong acid *vs.* weak base type of titration SEBE showed endpoint observation pale yellow to colorless at near to 27.00 ml.

In weak acid *vs.* strong base type of titration, SEBE showed endpoint observation yellow to colorless near to 22.26 ml volume of titrant while the synthetic methyl red indicator indicated yellow to colorless color end point near to 22.30 ml. In weak acid *vs.* weak base type of titration, SEBE showed endpoint observation yellow to colorless near to 21.83 ml volume of titrant while the synthetic mixed indicator indicated yellow to colorless clear end point near to 21.6 ml. In all these titrations the extract was found to be very useful and accurate for indicating the equivalence point (neutralization point) indicates indicator property. The above-reported results indicate the use of SEBE as a universal indicator as it shows the close endpoint as well as color change as compared with respective synthetic indicator [11].

CONCLUSION: From this review of the reported literature for the use of plant extract for their herbal indicator properties concludes that plant extract has potential to the role as an herbal indicator. The synthetic indicator used titrimetric analysis may have some toxic reaction or corrosive. So, when these synthetic indicators used during titration great care need to be taken to avoid the exposure with

skin which may cause allergic reaction or damage to the skin. An alternative to the synthetic indicator, herbal indicators shows a close end point as shown by the respective synthetic indicator. So, the either whole plant extract or isolated constituents can be used as herbal indicators as an alternative to the synthetic indicator. In the near future, the isolated component from plant extract has great demand as a natural indicator in pharmaceutical analysis.

ACKNOWLEDGEMENT: Authors are very much thankful to Principal Dr. D. M. Sakarkar for the encouragement.

CONFLICT OF INTEREST: Nil

REFERENCES:

1. Mendham J, Denney RC and Barness JD: Quantitative Chemical Analysis. New Delhi, Edition 6th, 2004: 296.
2. Bhagat VC, Patil RD, Channekar PR, Shetty SC and Akarte AS: Herbal Indicator as a substituent to the synthetic indicator. International Journal of Green Pharmacy 2008; 2: 162-3
3. Kasture and Wadotkar: Textbook of pharmaceutical analysis, Nirali Prakashan, Pune, Edition 11th, Vol. 1, 2005: 23-24.
4. Kadam S, Yadav A, Raje V and Waghmare K: Comparative study of natural and synthetic indicators. Der Pharma Chemica 2013; 5(1): 296-299
5. Okonkwo and Tochukwu J: *Hibiscus sabdariffa* anthocyanidins: a potential two-color end-point indicator In acid-base and complexometric titrations. International Journal of Pharmaceutical Sciences Review and Research 2010; 4(3): 123-128.
6. Agrwal S, Navin RR, Chouhan K, Raj CN, Jain S and Subramanium B: Isolation of herbal acid-base indicator from seed of *Punica grananum*. Journal of Pharmaceutical Chemistry Research 2011; 3(2): 168-171.
7. Jaspreet S, Arora K, Nain P and Deswal G: Herbal indicator as an upcoming trend in the tritremetric analysis. International Research Journal of Pharmacy 2011; 2(4): 177-179
8. Pathade KS, Patil SB, Kondawar MS, Naikwade NS and Magdum CS: *Morus alba* fruit herbal alternative to synthetic acid-base indicators. International Journal of Chem Tech Research 2009; 1(3): 549-551.
9. Vyas D, Shah BN, Modi DC and Lambole V: Screening and development of herbal acid-base ph indicator from traditional flowers. International Journal of Pharmaceutical Sciences. 2012; 3(3): 2211-2221.
10. More BH, Sakharwade SN and Sakarkar DM: Flower Extract of *Butea monosperma* as herbal indicator. Journal of Herbs, Spices & Medicinal Plants 2013; 19(2): 180-190.
11. Marulkar VS, Kavitake SS, Killedar SG and Mali DP: *Boerhavia erecta* Linn. stem bark extract a natural acid-base indicator. Asian Journal of Biomedical and Pharmaceutical Sciences. 2013; 16(3): 10-13.

How to cite this article:
Jadhav SS, Khillari VB, and Tembhurne SV: A comprehensive review on plant extract as an herbal indicator in tritremetric analysis. Int J Pharmacognosy 2017; 4(2): 54-59. doi link: http://dx.doi.org/10.13040/IJPSR.0975-8232.IJP.4(2).54-59.