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Research Article

Natural Indicator: To Measure the Acid-Base Degree of a Substance

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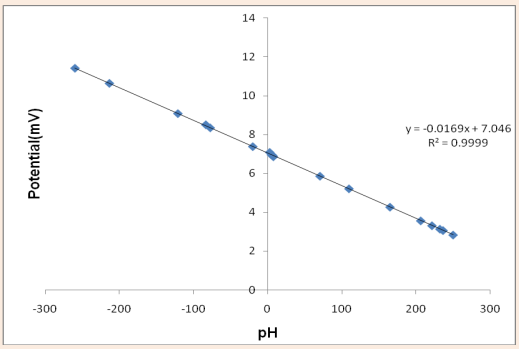
Abstract

This study investigated a natural indicator for acid-base solution which is collected from Bougainvillea and Yellow mari gold flower petals. Colour change of the indicator and pH range were determined for each type of acid-base solution. These values were comparable to those obtained from the standard indicators. Author suggests that pH vs. Potential curve helps a consultant for acid-base related work. Natural indicator is easily available, cheap, eco-friendly and could be excellent replacement for standard indicators.



Keywords: Acid-base, Bougainvillea, Flower petals, Natural indicator, pH, Potential, Yellow mari gold

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Introduction

Commercial indicators are expensive and some of them have toxic effects on users and can also cause environmental pollution [1-3]. The changes in hydrogen ion concentration accompanying the addition of a base to an acid are important for analytical purposes. Here we shall discuss how the pH of a solution changes during the course of acid-base reactions in aqueous medium. We shall see how the acidity of substances is measured. We shall produce natural indicating substances and we will determine the colour scale of them. In most cases we will use household substances. This type of work has been done by plant leaves, flower petals [4-8].

Changes in pH values in the neighbourhood of the equivalence point are of importance and enable use to select an indicator which will give the least titration error.

The substances in plant products such as tea, red cabbage or grapes reacts with acid (bases), resulting in changes at the molecular level which causes their colours to be different at different pH levels. All pH indicators, such as litmas paper, change colours depending upon whether they donate or accept protons (acids are proton donors and bases are proton acceptors).So, pH indicators are themselves acids or bases! Chemists pick selective natural dyes to indicate specific pH levels based on their colour changes.

The quality of a good indicator is that its colour change should be sharp, there would be contrasting colour change in acid-alkaline medium and the colour change occurs strictly at the neutralization point.

Indicators are dyes or pigments that are isolated from a variety of sources, including plants, flower petals, fungi and algae. Almost any flower that is, red, blue, pink, yellow, purple etc. in colour contains a class of organic pigments called anthocyanins that changes colour with pH. The use of natural dyes as acid-base indicators was first reported in 1964 by Sir Robert Boyle in his collection of essays Experimental History of Colours .These are dyes or pigments that are generated by the electronic structure of the dyes interacting with sunlight in plant tissues. The primary pigments occurring in plants are chlophylls and carotenoids, accumulated in plastids, and anthocyanins and betalanins which are

dissolved in vascuoler sap. Different pigments display an ability to absorb varied wave lengths of visible light. Flavonoids together with anthocyanins confer a wide spectrum of colour to flowers and fruits, including yellow, scarlet, red, pink, violet, blue. The intensive colours of some flowers, fruits and leaves are due to a combination of various pigments [9].

Experimental

Materials and Reagents

Household substances i.e., soda water, vinegar, mango juice, orange juice, wine, coca cola, milk, ammonia (20% solution) , shampoo, soap, tooth paste, washing powder, distilled water, tap water, cream, aspirin tablet, dispirin tablet were used. Pink Bougainvillea and yellow mari gold petals are used to prepare for natural acid base indicator.

Preparation of natural acid-base indicator

At first we will pick out the pink Bougainvillea and yellow mari gold flowers then cutting the petals of the flower. After that the petals were rubbed on a white card to produce natural pH paper. Then drying the cards for two hours and cutting the strips to use as a natural indicator.

pH Study: pH study of the above solutions were measured with a pH meter [Elico LI 614 pH Analyzer].

Result and Discussions

Table 1 pH and Potential value of some household substances

Serial No.	Substance	Potential(mV)	Acid pH	Basic pH
1.	Orange juice	249.9	2.83	
2.	Vinegar	236.3	3.063	
3.	Aspirin Tablets	232.1	3.133	
4.	Coca cola	221.4	3.31	
5.	Mango juice	206.2	3.56	
6.	Dispirin Tablets	164.8	4.265	
7.	Wine (Ram)	109.5	5.210	
8.	Cold cream(Pond's)	70.4	5.858	
9.	Distilled water	7.5	6.86	
10.	Milk (Amul)	6.4	6.932	
11.	Pond water	4.9	6.955	
12.	Tap water	2.6	7.085	
13.	Shampoo(Arnica)	-20.2		7.380
14.	Baking Soda(Satd. Soln.)	-77.6		8.347
15.	Tooth Paste(Colgate)	-83.5		8.504
16.	Soap(Wild Stone)	-121.2		9.081
17.	Surf(Safed)	-213.6		9.081
18.	Ammonia Soln.(20%)	-260.0		11.414

Table 2 The colour scale of pink Bougainvillea and yellow mari gold at different pH ranges

Serial No.	Substance	Potential(mV)	Acid pH	Basic pH	Natural Indicator	
					Pink Bougainvillea	Yellow Mari Gold
1.	Orange juice	249.9	2.83		No change	Deep yellow
2.	Vinegar	236.3	3.063		colourless	Deep yellow
3.	Aspirin Tablets	232.1	3.133		Light colourless	
4.	Coca cola	221.4	3.31		Light to deep violet	
5.	Mango juice	206.2	3.56		No change	
6.	Dispirin Tablets	164.8	4.265		Light yellowish red to colourless	
7.	Wine (Ram)	109.5	5.210		No change	
8.	Cold cream(Pond's)	70.4	5.858		No change	
9.	Distilled water	7.5	6.86		colourless	
10.	Milk (Amul)	6.4	6.932		colourless	
11.	Pond water	4.9	6.955		No change	
12.	Tap water	2.6	7.085		No change	
13.	Shampoo(Arnica)	-20.2		7.380	No change	
14.	Baking Soda(Satd. Soln.)	-77.6		8.347	No change	
15.	Tooth Paste(Colgate)	-83.5		8.504	No change	
16.	Soap(Wild Stone)	-121.2		9.081	No change	
17.	Surf(Safed)	-213.6		9.081	Light yellow	Light sap green
18.	Ammonia Soln.(20%)	-260.0		11.414	Deep yellow	Deep sap green

Table 3 Acid-Base Indicators

Indicator	Colour change interval(pH)	Acid	Base
Thymol blue	1.2-2.8	Red	Yellow
Methyl orange	3.1-4.4	Red	Yellow
Methyl red	4.4-6.2	Red	Yellow
Chlorophenol red	5.4-6.8	Yellow	Red
Bromothymol blue	6.2-7.6	Yellow	Blue
Phenol red	6.4-8.0	Yellow	Red
Thymol blue	8.0-9.6	Yellow	Blue
Phenolpthalein	8.0-10.0	Colourless	Red
Alizarin yellow	10.0-12.0	yellow	green

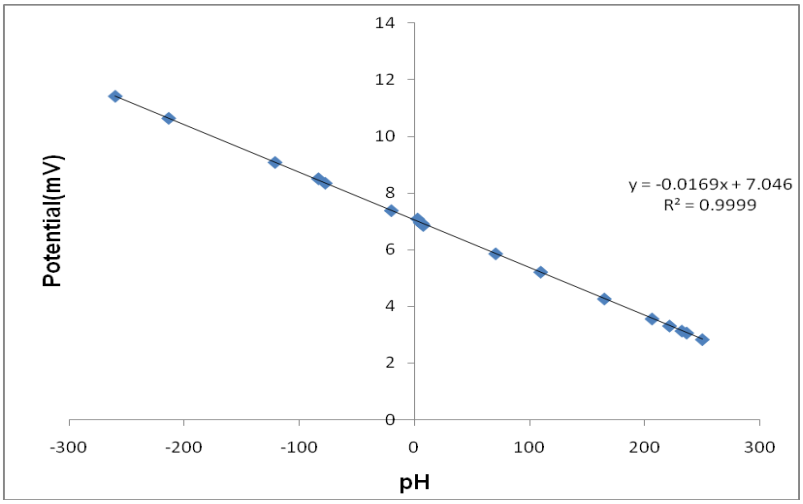

Figure 1 Plot of Potential (mV) vs. pH of different substances at room temperature

From **Table 1**, it has been found that at lower pH, Potential value increases as acidity increases. If we go up to the pH=11.414, then potential value decreases abruptly due to the increase in basicity. At pH 7 or near 7, potential value is too much less but not negative. If we go up to pH value 7.085 to 7.380, then it was observed that potential was -20.2 mV. So, it may be concluded that decrease in H^+ ion concentration, increase in potential (mV) value and vice versa. Therefore, potential value is a measure of pH in a solution which is much essential to measuring the pH of some household substances.

From Table 2, it has been found that pink Bougainvillea and yellow mari gold act as natural indicator. In strong acidic range pink Bougainvillea changes light to deep violet colouration. At neutral pH there is no significant change in colour. But at strongly basic range colour of pink Bougainvillea changes light yellow to deep yellow. So, pink Bougainvillea sheet acts as an natural indicator which is easily available and also eco-friendly.

Yellow mari gold also acts as a natural indicator. At highly acidic range colour of yellow mari gold is is deep yellow and at strongly basic medium colour changes light sap green to deep sap green. So, it is supported the nature of Alizarin yellow indicator in basic region(vide Table 3).Therefore, it is a good sign that yellow mari gold acts as a natural indicator which is also easily available and eco-friendly.

Both are good natural indicator which we are tested in our laboratory.

Figure 1, shows the pH vs. potential value of different household substances at room temperature. Intercept shows the neutral value of pH = 7.046. This is an interesting plot which helps the consultant to do the acid-base related work. If we know the value of pH of a solution, then we can tell the potential value of the corresponding solution.

Conclusions

This study investigated a natural indicator for acid-base solution which is collected from Pink Bougainvillea and Yellow mari gold flower petals. Colour change of the indicator and pH range were determined for each type of acid-base solution. These values were comparable to those obtained from the standard indicators.

The current paper suggests that pH vs. Potential curve helps a consultant for acid-base related work. Natural indicator is easily available, cheap, eco-friendly and could be excellent replacement for standard indicators.

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References

[1] F. O. Nwosu, F. A. Adecola and K. C. Ihedioha, Centrepoint, Vol. 12(1), 2004,74-89.
[2] K. S. Pathade, S. B. Patil, M. S. Konda-war, N. S. Naikwade and C. S. Magdum, International Journal of ChemTech Research, Vol. 1(3), 2009, 549-551.
[3] S. B. Patil, M. S. Kondawar, D. S. Ghod-ke, N. S. Naikwade and C. S. Magdum, Research Journal of Pharmacy and Technology, Vol. 2(2), 2009, 421-422.
[4] I.S. Udachan, A. K. Sahoo and G. M. Hend, International Food Research Journal, Vol. 19(1), 315-319.
[5] V. C. Bhagat, R. D. Patil, P. R. Channekar, S. C. Shetty and A. S. Akarte, International Journal of Green Pharmacy, Vol. 2(3), 2008, 162-163.
[6] S. Singh, S. B. Bothara, R. Patel and R. Ughreja, The Pharma Research, Vol. 5(2), 2011, 213-220.
[7] L. M. Piattelli, L. Minale and R. A. Nicolaus, Phytochemistry, 1965, Vol. 4(6), 817- 823 (abstract).
[8] Daniel A. Abugri, ohene B. Apea, > Pritchett, Green and Sustainable Chemistry, Vol. 2, 2012, 117-122.
[9] Flinn Scientific- Teaching Chemistry, eLearning Video Series, Publication No. 91564.

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