

ROSE ANTHOCYANINS AS ACID BASE INDICATORS

pH/Acid Base Indicators

- A pH indicator is halochromic chemical compound that is added in small amounts to a solution so that the pH (acidity or basicity) of the solution can be determined visually. **OR**
- A pH indicator is a chemical detector for hydronium ions (H_3O^+) or hydrogen ions (H^+).
- It can also be said that pH indicator changes color depending on whether they donate or accept proton (acids are proton donors and bases are proton acceptors).
- The indicator causes the color of the solution to change depending on the pH.

pH Indicator

Nature

- pH indicators are themselves acids or bases.
- A pH indicator is just a weak acid with differently colored acid and conjugate base forms.

Uses

- Main use of indicator is to test whether a solution is acidic or basic.
- pH indicators are frequently employed in titrations in analytical chemistry and biology to determine the extent of a chemical reaction.

pH indicator Sources

Artificial

- Many artificial acid-base indicators in a chemical laboratory have been in use which are made synthetically.
- phenolphthalein: colorless in acidic solution, pink in basic solution
- bromothymol blue: yellow in acidic solution, blue in basic solution

Natural

- plant pigments can act as acid-base indicators.
- Many flowers, fruits and vegetables contain chemical substances that change color in solutions of different pH.
- acid or base natural indicator, such as hibiscus, turmeric, red cabbage, and some other kinds of plants.

Plant pigments as acid-base indicators

- Many indicators have been extracted from plants.
- Willstatter in 1913, isolated and extensively studied blue and red pigments of flowers.
- Apples, autumn leaves, roses, strawberries, and cranberry juice appear red.
- Blueberries, cornflowers appear blue.
- Grapes, blackberries and red cabbage appear purple.
- All these color due to the presence of cyanidin based colorant molecules.

Natural Indicators

- Many naturally colored compounds can behave as acid-base indicators.
 - **Alizarin**
 - ❑ Is an orange dye present in the root of the madder plant; it was used to dye wool in ancient Egypt, Persia, and India.
 - ❑ In an 0.5% alcohol solution, alizarin is yellow at pH 5.5 and red at pH 6.8.
 - **Cochineal**
 - ❑ Is an acid-base indicator made from the bodies of dried female cochineal insects, found in Mexico and Central America.
 - **Curcumin or Turmeric yellow**
 - ❑ Is a natural dye found in curry powder. It turns from yellow at pH 7.4 to red at pH 8.6.
- Litmus, Esculin and logwood and a very important group called anthocyanin is plant based indicators.
- Here role of Anthocyanin will be discussed with the case of Flower *Rosa rosa* commonly known as rose (red).

Anthocyanins

- Anthocyanins are versatile and plentiful flavonoid pigments found in red/purplish fruits and vegetables, including purple cabbage, beets, blueberries, cherries, raspberries and purple grapes.
- Within the plant they serve as key antioxidants and pigments contributing to the coloration of flowers.
- Anthocyanins occur in all higher plants, mostly in flowers and fruits but also in leaves, stems, and roots. In these parts they are found predominantly in outer cell layers.
- Anthocyanins are water soluble strong colors and have been used to color food since historical times.

Anthocyanins

- Anthocyanins are pH dependent. When the acidity changes, the color changes.
- For example the color of red cabbage is enhanced with the addition of vinegar or other acid.
- When cooked in aluminum pans, which cause a more alkaline environment, the color changes to purple and blue.
- The extracts when treated with alkali turn green and show a greater absorbance in the range 575-625 nm depending upon the flowers used.

Flower color as indicators

- The flowers contain anthocyanin pigments whose color depends on pH; therefore they are used as pH indicators.
- Economic use of the pigments of some common flowers as acid/alkali indicators have been shown by using common flowers like *Hibiscus rosa-sinensis*, *Ipomoea fistulosa* and *Clitoria turnetea* contain various anthocyanin pigments in the form of purple-red, violet, and blue colors, resp.
- The acetone extracts of the pigments turn red in presence of acid and show absorption max. at 500 nm (*H. rosa-sinensis*) or at 525 nm (*I. fistulosa* and *C. turnetea*).

Present study/Use of Rose's color as pH indicator

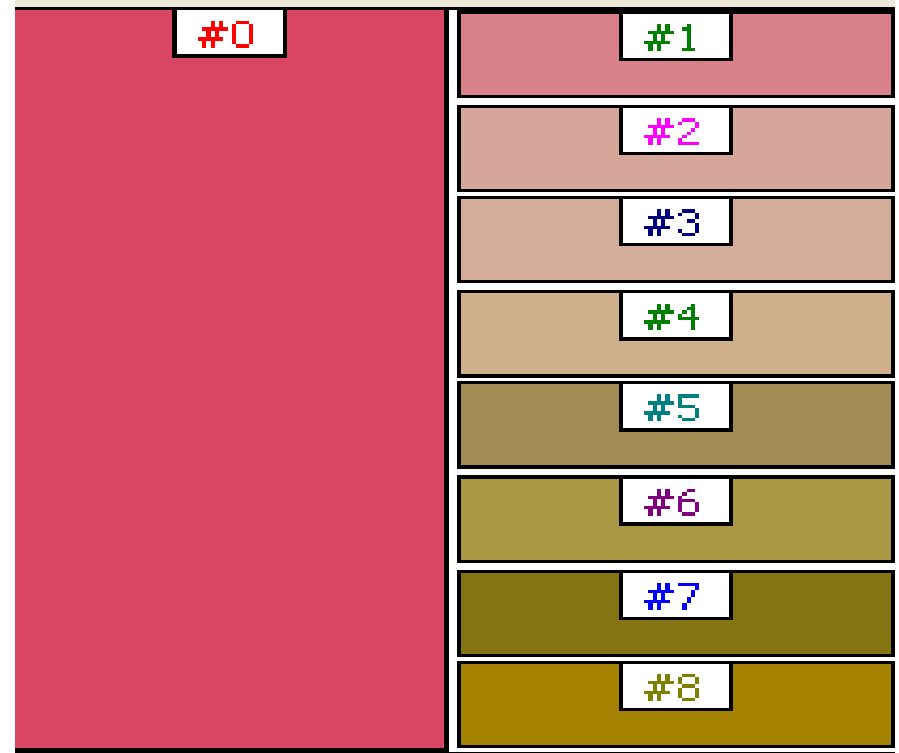
- Anthocyanin was extracted from rose flowers by 3 methods using methanolic solutions of 0.1% HCl, citric acid and tartaric acid.
- The anthocyanin was used as natural indicator in acid – base titration.
- The intrinsic pH of the extract was 2.88.
- Rose anthocyanin extract showed wavelength maxima change from 517 nm (dark pink) to 592 nm (green) between the pH range 2 to 9.

Rose anthocyanin

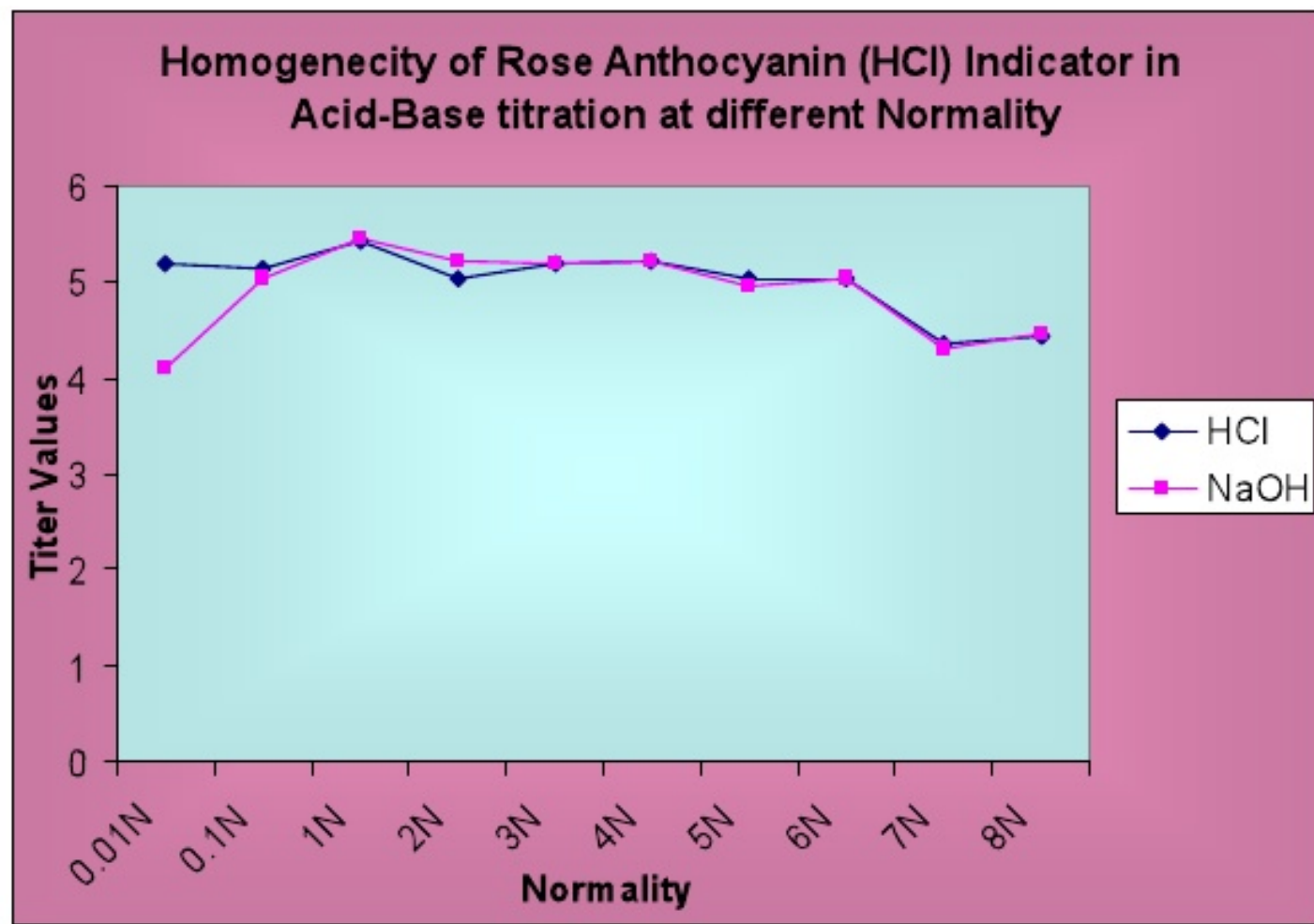
- The colorant present in the rose flower is mainly consisting of cyanidin, pelargonin or peonidin or to mixtures of these pigments.
- In acidic aqueous media (pH 2-9), there are three forms of cyanidin: the flavylum cation AH^+ , the carbinol B, and the quinonoidal base A.
- Equilibrium between the two neutral forms occurs exclusively by way of the flavylum cation.
- Hydration of the flavylum cation involves the formation of a C-O bond and a proton transfer.
- The existence of very small amounts of a third neutral form, the chalcone C, a prototropic tautomer of the carbinol B, has also been reported.

Rose anthocyanin color

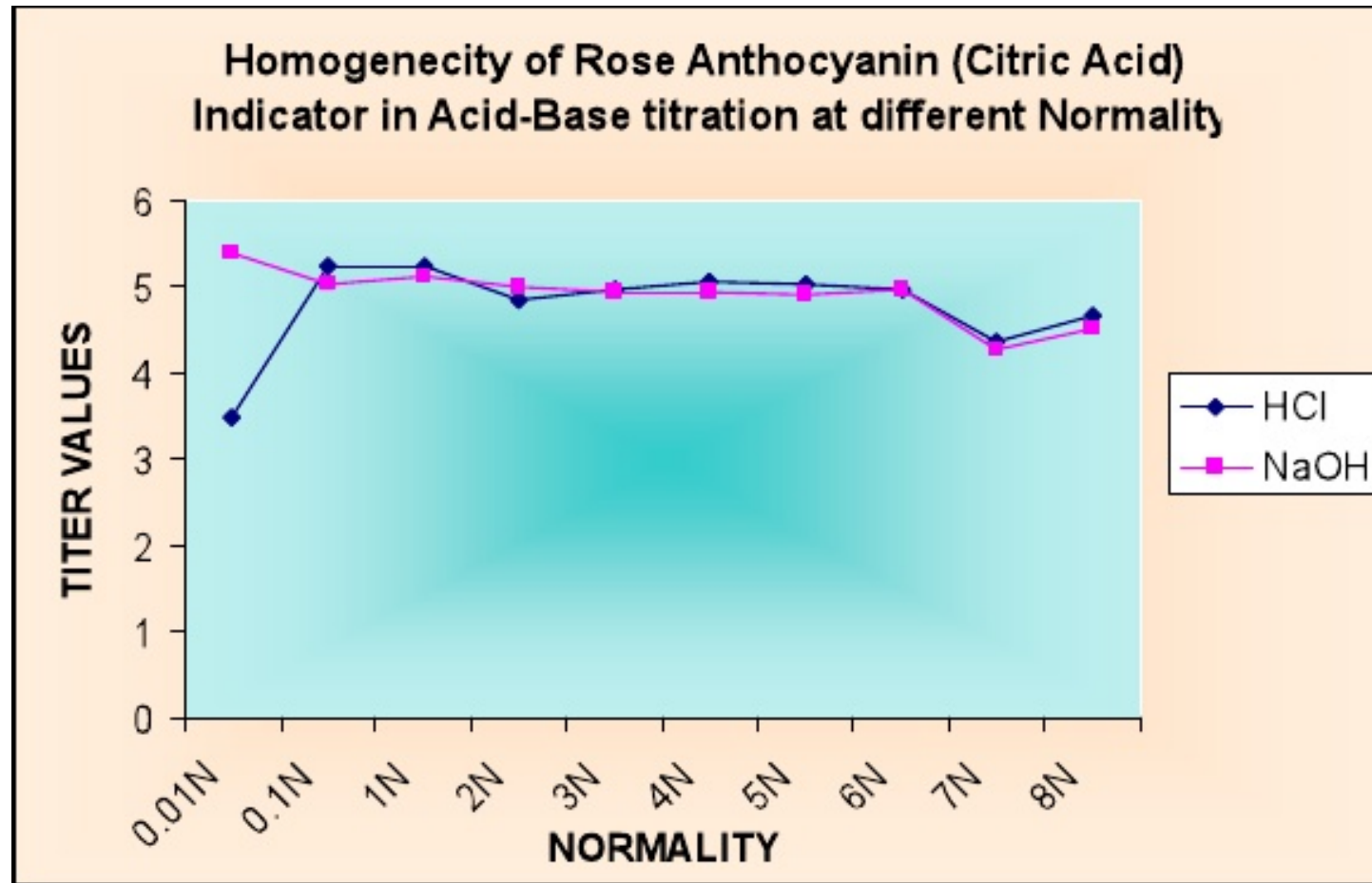
- Rose anthocyanin color scale on different pH show colors from pink to green.



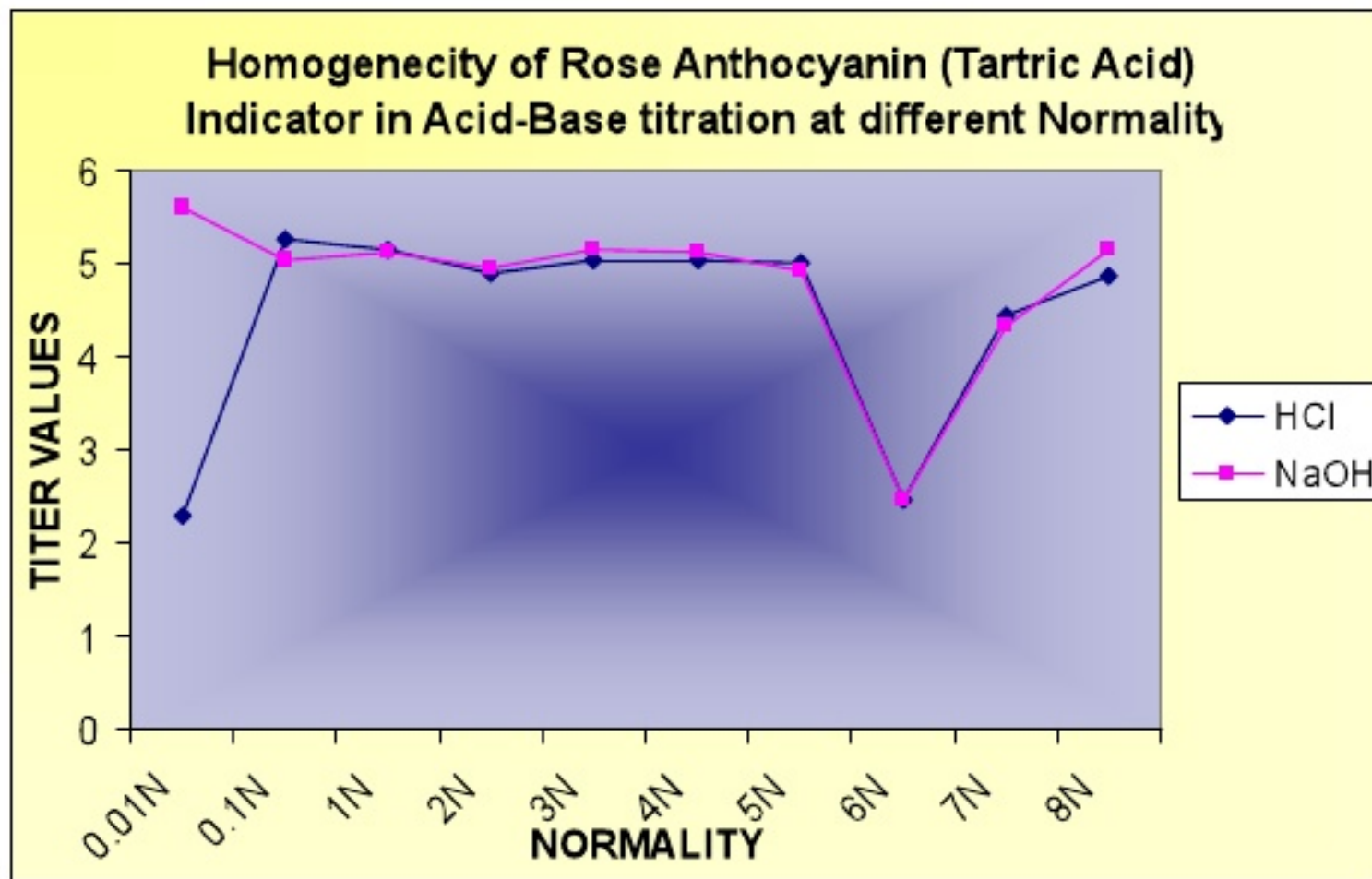
Titre values of HCl extracted rose Anthocyanin



Titre values of Citric acid extracted rose Anthocyanin



Titre values of Tartric acid extracted rose Anthocyanin



Conclusions

- The goal of this work was to propose a simple and cheap indicator.
- The selection natural dyes to indicate specific pH levels based on their color changes.
- Acidified methanolic extract of *Rosa rosa* were prepared and used as new indicators in quantitative analysis of standardization of NaOH and HCl solutions.
- Effect of using such natural extracts as indicators gave quantitative results as compared with conventional indicators with good agreement.