ROSE ANTHOCYANINS AS ACID BASE INDICATORS
pH/Acid Base Indicators

- A pH indicator is a 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 (H₃O⁺) 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 flavylium cation AH+, the carbinol B, and the quinonoidal base A.

- Equilibrium between the two neutral forms occurs exclusively by way of the flavylium cation.

- Hydration of the flavylium 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

Homogeneity of Rose Anthocyanin (HCl) Indicator in Acid-Base titration at different Normality
Titre values of Citric acid extracted rose Anthocyanin

Homogeneity of Rose Anthocyanin (Citric Acid) Indicator in Acid-Base titration at different Normality
Titre values of Tartric acid extracted rose Anthocyanin

Homogeneity of Rose Anthocyanin (Tartric Acid) Indicator in Acid-Base titration at different Normality

TITER VALUES

NORMALITY

HCl
NaOH
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.