Plant Polyphenols as Natural pH Indicators: A Reliable Alternative to Synthetic Indicators

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Abstract

Anthocynanins are natural pigments widely present in fresh fruits, vegetables and flowers. These are naturally occurring water soluble compounds available in a variety of colours. They have proved to be excellent antioxidants and have a great potential of applications in food and pharmaceuticals. The present study focuses on use of Anthocynanins as natural pH indicators. The aqueous extracts of beet root, red cabbages and pomegranate are found to exhibit strong colour change properties with variation of pH of the medium. These indicators are readily available, easy to prepare and eco-friendly.

Key Words: Anthocynanins, natural pH indicators

Introduction

A pH indicator is a substance which changes color according to how acidic or basic its environment is. Indicators are dyes or pigments that can be isolated from a variety of sources, including plants, fungi, and algae (Chavan et al, 2017). There are numerous natural acid-base indicators that can be obtained from common flowers, fruits and vegetables (Sharma et al 2017). The plant pigments known as anthocyanins are responsible for many of the red, blue and violet colours seen in plants (Ibrahim et al, 2011). Since they are water soluble, they are easily extracted for use in the laboratory.

These natural indicators are found in brightly colored flowers (Sajin 2012), red apple skin, cranberries, blueberries, red cabbage, cherries, grapes, red onion, peach skin, pear skin, plum skin, radish skin, rhubarb skin, black pansies, tulips, dark red roses and purple turnip skin (Vankar and Bajpai, 2010). These magnificent coloured compounds are well known for their antioxidant properties, and many health benefits including anti-aging properties (Vora et al 2009). Due to instability of colour, anthocyanins are widely used in food packaging industries to check pH changes in the food products, pharmaceuticals and cosmetic production (Sytar et al, 2012). It gives an opportunity to use it as an acid-base indicator rather than the conventional synthetic indicators. Therefore, it has been hypothesized that the plant extracts could be utilized as pH indicators.

Material and Methods:

Materials:

Fresh Pomegranate (*Punica granatum*), beet root (*Beta vulgaris*) and red cabbage (*Brassica oleracea*) were purchased from local market of Panvel region, Navi Mumbai, Maharashtra. Distilled water was used to prepare the aqueous extracts.

Soil sample from the nearby locality of the Panvel region was collected to determine the pH. Water samples from the Gadhi River near Panvel region was collected to check the pH.

Methods:

Preparation of extracts of fruits and vegetables

The fruits and vegetables were cleaned with distilled water and chopped in small pieces. The aqueous extracts were prepared (Flinn Scientific Chem Fax. 2016). Testing the acid base indicator efficacy of the aqueous extracts.

The aqueous extracts of beet root, pomegranate and red cabbage were tested with acid and base solutions and the results were recorded (Table No. 1). O.5 ml of each aqueous extract was added to 1 ml of acidic, neutral and basic solutions.

Preparation of soil samples for determination of pH-

The soil sample collected was used to prepare soil solution in sterile water (Hanlon E. A.). Three test tubes were prepared and 1 ml of this soil solution was taken in each test tube. 0.5 ml of each aqueous extract was added in each test tube and the colour change of the solution in each test tube was noted (Table No. 2).

Collection of water samples:

Fresh water sample from Gadhi River was collected to check its pH by natural pH indicators. 1 ml of water sample is tested with 0.5 ml of each extract and the colour change was observed (Table No. 3).

Results and Discussion:

The results of the colour changes of the aqueous extracts in acidic, neutral and basic medium is as per Table No. 1. The change in colour of the anthocyanins from the extracts reveals that these natural compounds are potent acid base indicators.

Table No. 1 Colour changes of the aqueous extracts in different pH medium

Aqueous extract	Colour of aqueous extract	Colour in Acidic medium	Colour in Neutral medium	Colour in basic medium
Beet root	Dark red	Dark Red	Dark pink	Yellow to Green
Pomegranate	Red	Red	Pinkish white	Yellow to light brown
Red cabbage	Purple	Red	Blue	Yellow to light green

This table of colour change is followed to check the pH of soil and water samples.

Table No. 2 Determination of pH of soil sample by aqueous extracts:

The soil solution was treated with aqueous extracts of beetroot, pomegranate and red cabbage to determine its pH.

Aqueous extract	Colour of soil sample	pH of soil sample
Beet root	Red	Acidic
Pomegranate	Red	Acidic
Red cabbage	Red	Acidic

Table No. 3 Determination of pH of water sample by aqueous extracts:

Aqueous extract	Colour of water sample	pH of water sample
Beet root	Green	Basic
Pomegranate	Yellow to brown	Basic
Red cabbage	Yellow	Basic

It was observed that the soil sample has an acidic pH while the water sample has a basic pH. From the above tables it is clear that the plant extracts contain the anthocyanins which change colour in different pH solutions. The synthetic indicators which are used widely in laboratories do the same function but are hazardous to health and environment. They are slightly expensive and are unavailable. These problems can easily be solved by using brilliantly coloured fresh fruits, vegetables and flowers. These natural pH indicators are economic, safe, eco-friendly and an efficient alternative to the traditional acid base indicators.

Conclusion:

The results obtained prove the efficacy and accuracy of the plant extracts as pH indicators. Such type of studies will definitely engage the students and budding researchers to find out more economic and eco-friendly methods. These natural indicators can readily be prepared in any laboratory conditions. They may also help to provide a baseline idea about the condition of soil in any farm and potability of water in context with its pH. These extracts can be used in small scale food industries due to their economy, simplicity and wide availability.

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