Tradescantia pallida Leaf Extract as a pH Sensitive Chemical Indicator

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Abstract

Anthocyanins are water-soluble natural pigments with good anti-oxidant and antibacterial properties, and their colours are pH-sensitive to the environment. At present, the use of plant anthocyanins as indicators and smart packaging film has attracted increasing attention in the field of food engineering. The use of anthocyanin-based pH-sensitive smart packaging films can not only effectively prolong the shelf life but also monitor the freshness of food.

The present study focused on developing pH-sensitive pigments from *Tradescantia pallida* for use as chemical indicators. The ethanolic extract of leaves of *Tradescantia pallida* was prepared and further checked for their colorimetric pattern in solutions of varying pH. The results obtained were positive and showed observable changes in response to pH. The observed color changes in response to variations in pH levels indicate the extract's ability to serve as a reliable indicator of acidity or alkalinity. The thermal and photo stability studies carried out on the extract indicated that the colour changing properties of the extract were affected in the presence of light and temperature. This finding holds significant implications for industries such as food packaging, where monitoring pH levels is crucial for ensuring product quality and safety**.**

Keywords: anthocyanin, *Tradescantia pallida,* pH-sensitive

1. Introduction

Tradescantia pallida is a tender evergreen perennial native to northeast Mexico (from Tamaulipas to Yucatan) grown as an ornamental for its striking purple foliage. Synonyms for *Tradescantia pallida* include *Setcreasea pallida, Setcreasea jaumavensis, Setcreasea purpurea, Setcreasea lanceolate,* Purpleheart, Wandering jew, Spiderwort, and Purple Queen.[1] The Commelinaceae family, which has around 700 species and 50 genera). High amounts of antioxidant substances, including phenolics, tannins, flavonoids, and secondary metabolites with the ability to scavenge free radicals and reduce ferric iron, are found in Tradescantia species.[2]
It has long been believed that the plant enhances blood flow and serves as an antioxidant, anti-inflammatory, and detoxifying supplement. This plant was used by the Ayta populations of Porac, Pampanga, Malaysia, to heal eye sores. According to some sources, the facility was also used to filter and purify volatile organic compounds in the air. According to reports, *T. pallida* is an excellent substitute for *in situ* mutagenesis testing. The leaf methanol extract exhibited encouraging antibacterial and antioxidant properties. Zinc oxide nanoparticles mediated by *T. pallida* have been found to have anti-cervical cancer cell line action. Using suggested methods, we report the pharmacognostic analysis of *T. pallida* leaves in this publication [3]. *T. pallida* has also been utilized traditionally for its ability to improve blood circulation, minimize eye strain, and have anti-inflammatory and antitoxic properties. *T. pallida* extracts were subjected to phytochemical screening studies, which identified the presence of alkaloids, tannins, and carbohydrates in high, moderate, and negligible levels, respectively [4,5].

Figure 1: *Tradescantia Pallida*

Alkaloids, flavonoids, phenolics, and saponins have been the most identified phytochemical compounds in Tradescantia species. Apigenin, luteolin and flavonols, 6-hydroxy luteolin, and tricin have been the main identified flavonoids (C-glycosides). The constituents are responsible for the plants antioxidant, cytotoxic, antifungal and antibacterial activity. [6]

Anthocyanins

Anthocyanins are a class of natural pigments responsible for the vibrant red, purple, and blue hues found in many fruits, vegetables, and flowers. These compounds belong to the flavonoid group of polyphenolic compounds, which are widely recognized for their potential health benefits.[7] Anthocyanins play essential roles in plant physiology, including attracting pollinators, protecting against UV radiation, and serving as antioxidants to combat oxidative stress.[8] Beyond their aesthetic appeal in the plant kingdom, anthocyanins have garnered significant attention for their potential health-promoting properties in humans, including anti-oxidant, anti-inflammatory, and cardiovascular benefits. This has led to growing interest in incorporating anthocyanin-rich foods and supplements into diets as a means of supporting overall health and well-being.[9,10]

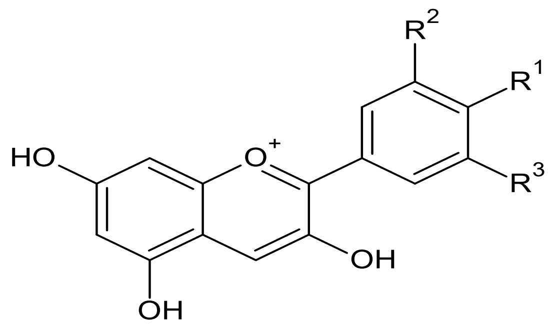


Figure 2: Structure of anthocyanin

Natural pigments called anthocyanins are soluble in water and have strong antibacterial and antioxidant qualities. They also change color depending on the pH of the surrounding environment. In addition to successfully extending the shelf life, anthocyanin-based pH-sensitive smart packaging films have shown to be useful in tracking the freshness of food items including cheese, fish, pork and prawns. Films based on anthocyanins also find application as labels for colorimetric sensors. [11-24] The present study aims to extract anthocyanin pigment from the leaf extract of *Tradescantia pallida* and explore their pH-sensitive properties.

2. MATERIALS AND METHODS

2.1 Collection and identification of plant material

The leaves of *Tradescantia pallida* collected from a local garden were authenticated at the Foundation for Revitalization of Local Health Traditions (FRLHT) (FRLH Acc. No. 6250).

2.2 Preparation of *Tradescantia pallida leaf* extract

Fresh leaves of Tradescantia pallida leaves were thoroughly cleaned and dried in the shade for 3 days. The dried leaves were powdered and soaked in ethanol for 24 hours. The extract was filtered to separate the leaf debris and stored in a cool place away from light.

 ISSN NO: 1434-9728/2191-0073

2.3 Identification of Chemical Constituents

Anthocyanins were identified by the following chemical tests.

***Sulfuric acid test* :**2 mL of *T. pallida* leaf extract was transferred into a clean test tube. 1 mL of concentrated sulfuric acid (H_2SO_4) was added to the test tube. The contents were gently mixed by swirling the test tube. The test tube was observed for the formation of an interface (the boundary between the extract and the sulfuric acid). The presence of anthocyanin was indicated by the development of an orange coloration at the interface [26].

***Sodium Hydroxide test* :**2 mL of the *T pallida* leaf extract was taken and transferred into a clean test tube. Using a dropper or pipette, 2 drops of 1 N sodium hydroxide (NaOH) solution was added to the test tube containing the extract. It was mixed thoroughly, and the color of the solution was observed. The presence of anthocyanin was indicated by a change in color to blue or bluish green. Observations were recorded [26].

2.4. Testing of extract in different pH

Solutions of different pH (pH 2.0, 3.0, 5.8. 6.4, 7.6, 8.0, 9.4, 12.0) were prepared as per the procedure given in Indian Pharmacopoeia.

Solutions of different pH were taken into individual test tubes and 1 ml of *T pallida* leaf extract was added to it. The change in color of the contents was observed. A smartphone app “Colorpicker” was used to identify and quantify the changes in color shades.

2.5 Stability testing of extract

The influence of factors such as temperature and light on the stability of anthocyanins in the plant extract was studied.

2.5.1 Photodegradation

To study the degradation of anthocyanins under the influence of light, the plant extract was exposed to natural light indoors. It was observed for changes in color and tested for responsiveness to different pH solutions on the second, fourth, and sixth day.

2.5.2 Thermal degradation

To study the effect of temperature on the stability of anthocyanins, the plant extract was placed at room temperature and at 40°C and 60°C for 1 hour and observed for color changes and tested for responsiveness to different pH solutions. [17,27,28]

3. RESULTS

3.1 Preparation of *T. Pallida* extract

Anthocyanins were extracted from the plant *Tradescantia pallida* by ethanolic extraction method. The fresh extract was then subjected to chemical tests to ascertain the presence of anthocyanin.

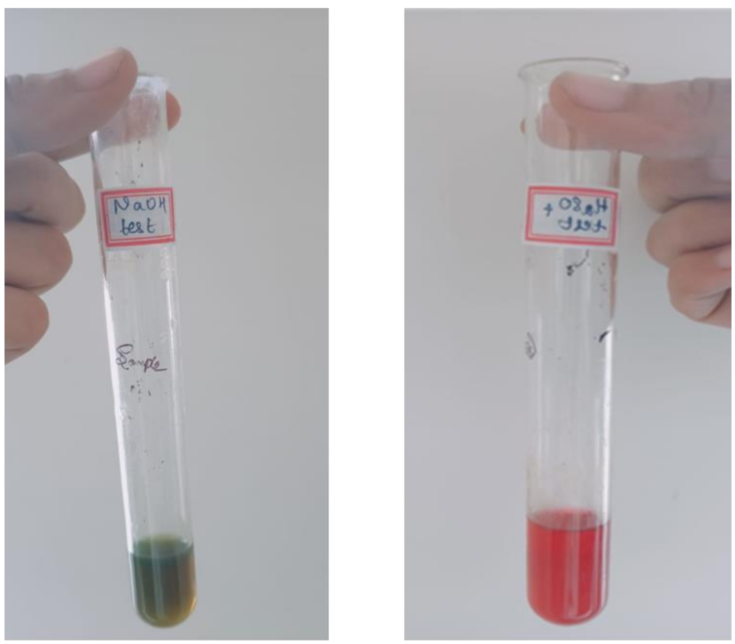
3.2 Identification of chemical constituents of *T. Pallida*

Confirmatory test for anthocyanins

The confirmatory tests for anthocyanins were performed using standard procedures. The presence of anthocyanins was confirmed by a bluish green and orange colour in sodium hydroxide and sulfuric acid respectively (Table 1 and Figure 3).

Table 1: Confirmatory tests for anthocyanins

Sl. No	Test for anthocyanin	Result- colour
1.	Sulfuric acid test	Positive – bluish green colour
2.	Sodium hydroxide test	Positive- orange colour



Bluish green colour **Orange colour**

Figure 3: Colour Reactions

3.3 Testing of the colorimetric pattern of *T. Pallida* Extract in various pH Solution

The colorimetric pattern of *T. pallida* extract in various pH was determined with an Android application, color picker. The app was able to differentiate various shades of colors and suggest appropriate names (Table 2).

ISSN NO: 1434-9728/2191-0073

Table 2: Results of Analysis of Colorimetric Pattern

pH	Colour with pure extract	Colour with film	Colour
2	Pale carmine	Pale carmine	
3	Sangria	Dark tan	
5.8	Wine	Wine	
6.4	Dark scarlet	Wine	

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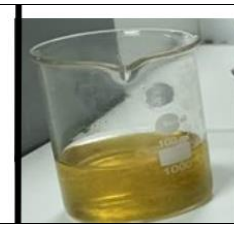
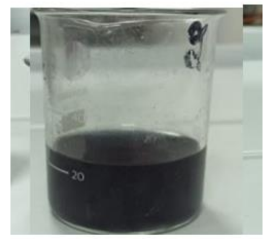
7.4	Russet	Russet	
8	Dark slate grey	Russet	
9.4	Arsenic	Arsenic	
12	Sepia	Grey asparagus	

This analysis indicates the color changes that occur at different points along the pH scale summary, with pure extract and with film.

Assessment of stability of prepared extract

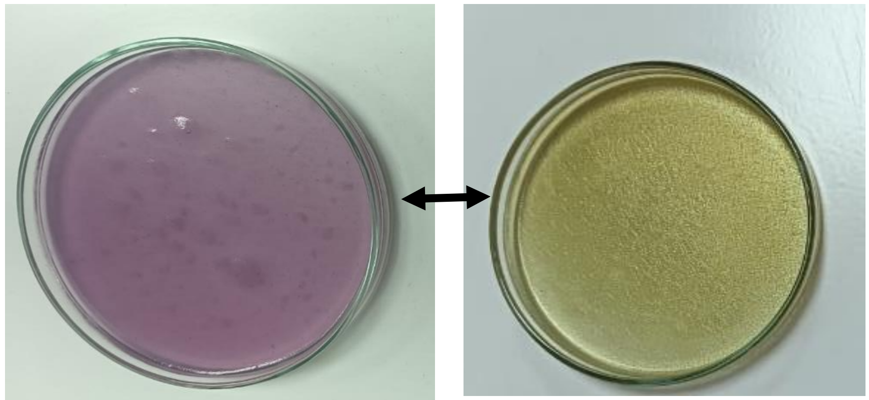
The influence of factors such as temperature and light on the stability of anthocyanins in the plant extract was studied.

Photo Degradation

The color of the extract was purple. On Day 2 the color changed to light green and on Day 6 it was changed to Olive green and responsiveness to the different pH solutions was lost (Figure 4).

Thermal Degradation

The effect of temperature on the stability of anthocyanins, and plant extract were studied. The purple extract lost its responsiveness to different pH solutions after storage at 40˚C and 60˚C for 1 hour. The color of the extract changed to olive green, indicating a change in chemical properties (Figure 5).



Day 1 Day 6

Figure 4: Effect of light on extract

Figure 5: Effect of temperature on extract

4. Conclusion

This work has explored the potential of natural resources to produce sustainable and effective alternatives to synthetic compounds, contributing to environmental conservation efforts and meeting the growing demand for eco-friendly solutions in various industries. One of the primary conclusions drawn from this study is the effectiveness of *Tradescantia pallida* leaf extract in producing pH-sensitive pigments. The observed color changes in response to variations in pH levels indicate the extract's ability to serve as a reliable indicator of acidity or alkalinity. This finding holds significant implications for industries such as food packaging, where monitoring pH levels is crucial for ensuring product quality and safety. The extract exhibited significant color changes in response to variations in pH levels, indicating its suitability for such applications. Utilizing Tradescantia pallida leaf extract presents an environmentally friendly alternative to synthetic pigments commonly used in chemical indicators and smart packaging materials. By harnessing natural resources, this approach contributes to sustainability and reduces the reliance on potentially harmful chemical compounds. The pH-sensitive pigments derived from *Tradescantia pallida* leaf extract demonstrated versatility and adaptability across a range of pH conditions. This characteristic is essential for their practical application in diverse industries, especially for food packaging.

Acknowledgment

The authors would like to thank M.S. Ramaiah University of Applied Sciences for supporting this project and providing the necessary facilities.

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