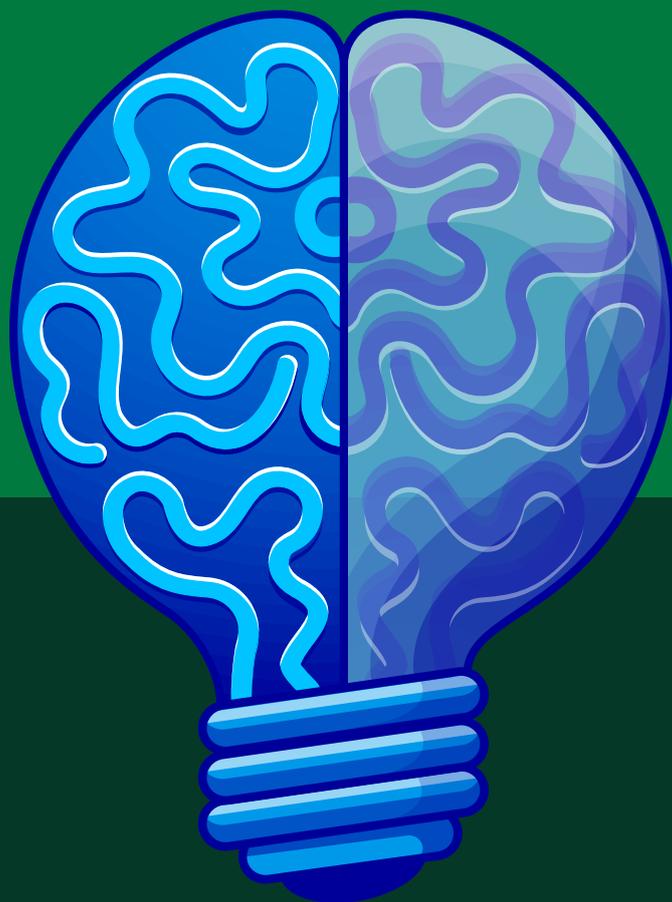


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PERAK BRANCH

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BIOLOGY ~ CHEMISTRY ~ PHYSICS

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EDITORS

Pn. Rosliza Ali
Pn. Nunshaimah Salleh
Pn. Norsakina Zurina Zulkifli
Pn. Adibatul Husna Fadzil
Pn. Yanti Yaacob
Pn. Lili Widarti Zainuddin

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Faculty of Applied Sciences,
Universiti Teknologi MARA,
Perak Branch Tapah Campus,
35400 Tapah Road,
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Preface

The Scientific Project Colloquium offers a platform for publishing Diploma Science final year projects (FYP). The objective is to effectively distribute research findings throughout all scientific disciplines. The primary objective of including final year projects into the course curriculum is to encourage students to put their theoretical knowledge into practical applications.

We would like to express our gratitude to our primary establishment, the Faculty of Applied Sciences and Universiti Teknologi MARA, Perak Branch, for their invaluable assistance.

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Editors

Rosliza Ali

Nunshaimah Salleh

Norsakina Zurina Zulkifli

Adibatul Husna Fadzil

Yanti Yaacob

Lili Widarti Zainuddin

Universiti Teknologi MARA

Perak Branch Tapah Campus

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EVALUATION OF RED ROSE EXTRACT AS A NATURAL DYE: A FOUR-METHOD APPROACH TO COLOR VISION ANALYSIS

Nur Nadirah Rodzali*, Siti Nur Azmu'i Abdullah, Tengku Nur Alia Masyitah Tengku Amri, Noor Hafizah Nor Apindi, Saufiah Alawiyah Shamsul Nizam, Nurnajaa Farzanah Alauddin, Maisarah Hanifah, Muhammad Amiruddin Ismail

Faculty of Applied Sciences, Universiti Teknologi MARA, Perak Branch Tapah Campus, 35400 Tapah Road, Perak, Malaysia

*E-mail: nurnadilah@uitm.edu.my

Abstract: Due to their environmentally benign qualities, natural dyes are growing ever more popular as long-term substitutes for synthetic dyes. This study investigates the extraction of natural dye from rose petals and its application to cotton fabric, aiming to evaluate its colour vision. Rose petals were chosen for their abundant availability and potential as a sustainable dye source. As concerns about the negative effects of synthetic colorants on the environment and human health grow, natural dyes offer low toxicity, biodegradability, and renewable sourcing. Four extraction techniques (acetic acid, sodium hydroxide, ethanol and distilled water) were applied to fresh rose petals, and the extracted dyes were tested on cotton fabric. The color properties of the dye extracted from rose petals varied significantly depending on the extraction medium. Acidic extraction yielded the most vibrant and stable purple hue. In contrast, alkaline extraction resulted in a dull orange-brown tone that faded over time. Aqueous extraction produced the lightest color, a pale pink, while alcohol-based extraction generated a medium brown shade. These findings suggest that the extraction medium plays a crucial role in determining both the intensity and stability of the color obtained from rose petals. These results are in keeping with earlier studies that demonstrated anthocyanin pigments are more stable when extracted in an acidic environment but deteriorate when extracted in an alkaline environment.

Keywords: *Natural dye, Extraction technique, Dried rose petals, Colour vision*

INTRODUCTION

The use of synthetic dyes in the textile industry has caused major health and environmental issues because of their toxicity, lack of biodegradability, and detrimental ecological effects. On the other hand, natural dyes provide environmentally benign substitutes, although they frequently have poor fastness qualities, uneven repeatability, and low colour yields (Pizzicato et al., 2023). The extraction of natural dyes is highly influenced by the solvent medium, which affects both the yield and the shade of the dye. Common solvents used in rose petal include acetic acid (acidic medium), sodium hydroxide (alkaline medium), ethanol (organic solvent), and distilled water (aqueous medium). Acidic media like acetic acid help stabilize anthocyanins and enhance red to purple hues, while alkaline extraction often leads to pigment degradation, producing dull brownish shades (Salman et al., 2023; Sadaf et al., 2024). Ethanol is effective in extracting both polar and moderately non-polar compounds, yielding deeper brownish or reddish tones (Patil, 2016). Due to their vivid colours and bioactive qualities, rose petals have become a popular and environmentally responsible natural dye. The pigments in question, which are primarily anthocyanins and include molecules of the malvidin, pelargonidin, cyanidin, peonidin, and delphinidin types, are soluble in water and react with pH and binding interactions to change colour. (Iwashina, 2015). In this study, the extraction is performed across four different solvent systems (acid, base, alcohol, aqueous), followed by cotton dyeing under controlled settings. The colour vibrant from the extraction is observed. In practical applications, rose derived anthocyanins have shown considerable potential in textile dyeing. A 2021 study reported successful extraction of anthocyanin dyes from *Rosa indica* petals, achieving varied shades on wool fabrics using both chemical and bio-mordants to enhance colour intensity and fastness. Notably, these dyed fabrics also displayed antioxidant, anti-inflammatory, and antibacterial properties, underscoring roses' multifunctional value in textile applications (Adeel et al., 2021).

METHODOLOGY

Preparing and scouring of cotton clothes

Cotton fabric (2.5 x 2.5 inches) was placed in a 200 ml beaker and boiled with 100 ml of 10% (w/v) sodium hydroxide solution for 15 minutes to remove starch and other impurities from the cloth. Then, the cotton cloths were thoroughly washed with cold distilled water to remove any remaining impurities. (Grover & Patni, 2011)

Aqueous extraction method

10 g of fresh red rose petals was boiled at 100 °C for 30 minutes in 100 ml distilled water. The decolorized petals were taken out from extraction solvent. (Patil et al., 2016).

Alkaline extraction method

10 g of fresh red rose was added in 100 ml of 1% (w/v) sodium hydroxide solution and boiled at 100 °C for 30 minutes. The decolorized petals were removed from the extraction solvent (Patil et al., 2016).

Acidic extraction method

10 g of fresh red rose petals was added in 100 ml of 1% (v/v) acetic acid solution. The mixture was boiled at 100 °C for 30 minutes. The decolorized petals are removed from the extraction solvent (Patil et al., 2016).

Alcohol extraction method

10 g of fresh red rose petals was added in 100 ml of 50% (v/v) alcohol (ethanol) solution and boiled at 100 °C for 30 minutes. The decolorized petals were removed from the extraction solvent (Patil et al., 2016).

Dyeing method

A (2.5 x 2.5 inch) cotton fabric was immersed in the beaker with the extracts. After 30 minutes, the fabric was removed and left to dry for one day to observe the intensity of the colours.

FINDINGS

The different colour shades were obtained from various extracts of red rose petal. The extracts show variation in colour, and which mainly depends upon the extraction solvents. Based on the observation, cotton fabric immersed in acetic acid extraction produces a vivid purple colour in 30 minutes showing it has high and strong pigmentation. In comparison, cotton fabric in sodium hydroxide extraction shows dull orange-brown shade. Figure 1 shows the appearance of colour shade in four different extractions.

The extraction from ethanol on cotton fabric shows muted light brown with low brightness and moderate intensity while aqueous extraction forms a pale pinkish colour dye. All results are compared to each other, and it was found that acid has a strong effect on cotton fabric. In this research it is found that red rose colour shade changes properties when in acidic it gives strong shade on cotton fabric as compared to the aqueous, alcohol and alkaline extraction. Rose petals are rich in anthocyanins, a group of water-soluble flavonoid pigments responsible for red, pink, purple, and blue hues in plants (Wang et al., 2022). Anthocyanins are highly pH-sensitive, and their structural transformations under varying pH directly influence the color of extracts (Gonzalez-Barrio et al., 2009). Anthocyanins exist in several structural forms depending on pH like at acidic pH ($\text{pH} < 3$), anthocyanins predominantly exist as flavylium cations, which absorb light strongly and appear vivid red or pink (Brouillard & Dangles, 1994). In a study by Sadaf et al. (2024), rose petals were extracted using acidic, alkaline, and aqueous methods and applied to cotton fabric.



Figure 1 Dyeing process of cotton fabric

The acidic extraction, which likely involved acetic acid, produced the most vibrant and persistent purple colour on the fabric. This indicates that the acidic environment enhances the extraction and stability of anthocyanins, resulting in deeper and more durable hues. While at neutral pH, the pigments undergo hydration and form colourless carbinol pseudobases or pale chalcone structures, this leads to a lighter, more muted tone, often pale pink rather than vivid red or purple (Brouillard & Dangles, 1994; Salman et al., 2023). According to a study by Al-Alwani et al. (2023), wool textiles dyed with rose petal extract at an acidic pH (pH 2-3) exhibited excellent

binding and noticeably higher colour strength than those dyed at a neutral or basic pH. The study on 2023 by Salman et al, four distinct solvent systems aqueous (neutral), acidic (pH = 2), alkaline (pH ≈ 11), and basified methanol have been used to study the extraction of rose petal pigments for use in wool dyeing. Out of all of them, the acidic extraction procedure, which was carried out at 40°C for 35 minutes while adding 2 g/100 mL of salt, showed the greatest tint (K/S) values (Kubelka-Munk theory), indicating higher dye uptake and stronger colour strength. This implies that, in contrast to neutral, alkaline, or methanol-based extraction techniques, acidic conditions promote superior stability of anthocyanin pigments, resulting in more vivid pigmentation (Salman et al., 2023).

This research also indicate that cotton is a good fabric for dyeing as it has high absorbency power, so it absorbs dye. Cotton is a natural fabric so applying natural dye on it is ecofriendly too. Cotton due to high absorbency power resist shade change and staining properties in colour fastness to wash and colour fastness to light test (Sadaf et al., 2024).

CONCLUSIONS

This study successfully retrieved colour from rose petals with four different solutions: aqueous, alkaline, acidic, and alcohol. The results showed that the acidic extraction procedure generated the most brilliant and stable colour, whilst the alkaline, alcohol, and aqueous extractions produced increasingly weaker hues. Red rose flower extracts serve as an economical and environmentally friendly source of natural dyes, with wide applicability in sectors such as textiles, cosmeceuticals, leather tanning, and food coloring.

COMPLIANCE OF ETHICAL STANDARDS

Not applicable.

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Tarikh : 20 Januari 2023

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Sekian, terima kasih.

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Timbalan Ketua Pustakawan

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