



EXTRACTION AND COMPARATIVE ANALYSIS OF DYES FROM SELECTED TUBERS FOR INDUSTRIAL APPLICATION

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ABSTRACT: A dye is a coloured substance that chemically bonds to the substrate to which it is being applied, this distinguishes dyes from pigment which does not. Dyes derived from natural materials such as plant leaves, roots, bark, insect secretions, and minerals were the only dyes available to mankind for the coloring of textiles until the discovery of the first synthetic dye in 1856. Rapid research strides in synthetic chemistry supported by the industrialization of textile production not only led to the development of synthetic alternatives to popular natural dyes but also to a number of synthetic dyes in various hues and colors that gradually pushed the natural dyes into oblivion. The following materials was used; Onion skin and Turmeric powder. The samples were prepared classically in the laboratory by extraction method. The results show that dye extraction from onion skin and turmeric demonstrated the feasibility of obtaining vibrant and distinctive natural colors. The sensitivity of these dyes to pH variations, along with the successful identification through spectroscopic analysis, opens avenues for their potential use in various applications. While its color fastness is generally satisfactory. In conclusion, with further research and innovation optimization may be pursued to enhance the practical viability of these natural dyes in different industries. Hence, this study goes a long way to promote the use of natural raw materials for dyes production at reduced cost, and for industrial development.

Keywords: Dyes, Insect secretions, Onion Skin, plant Leaves, Turmeric, Turmeric powder.

1.0 INTRODUCTION

Natural dyes are derived from various sources, such as plants, animals, and minerals. Unlike synthetic dyes, they are obtained from renewable resources, making them environmentally friendly. The use of natural dyes has a long history, dating back to ancient civilizations, where people extracted colors from plants and other organic materials (Adeel et al,2013).

Throughout history, natural dyes have been used to color textiles, pottery, and other materials. In many cultures, the knowledge of extracting and using natural dyes was passed down through generations, and specific dyeing techniques and recipes were closely guarded secrets (Rehman et al, 2013).

In recent years, there has been a renewed interest in natural dyes due to their sustainable and eco-friendly nature. With growing concerns about the environmental impact of synthetic dyes, many artisans, designers, and consumers are turning to natural dyes as a more sustainable alternative (Rehman et al, 2013).

Natural dyes also offer a wide range of colors, from earthy tones to vibrant hues, and they can create unique and beautiful variations in color due to the natural variations in the source materials. Additionally, natural dyes can create a connection to the natural world and traditional craftsmanship, adding a sense of authenticity and uniqueness to the dyed products (Adeel et al,2013).

Despite their many benefits, natural dyes also have some limitations, such as the availability of certain colors, the need for larger quantities of materials, and the variability of results. However, ongoing research and innovation in natural dyeing techniques are addressing these challenges and making natural dyes more accessible and practical for modern use (Samantaa et al, 2009).

Natural dyes offer a sustainable, environmentally friendly, and aesthetically pleasing alternative to synthetic dyes. Their rich history and cultural significance, along with their unique and varied color palette, make natural dyes a valuable and important part of the textile and artistic world (Ali et al, 2007).

Natural dyes have gained considerable attention as sustainable alternatives to synthetic dyes, driven by both environmental concerns and a growing interest in traditional and eco-friendly practices. Among the myriad sources of natural colorants, onion skin and turmeric stand out as prominent contributors to the palette of natural dyes. This study aims to perform a chemical comparative analysis of the natural dye pigments derived from onion skin and turmeric, elucidating their respective chemical compositions and properties (Samanta et al, 2015).

This analysis delves into the key chemical components of each natural dye, exploring factors such as color range, stability, pH sensitivity, and potential health benefits. A comparative examination of these characteristics will not only deepen our understanding of the chemistry behind these natural dyes but also inform practical applications, such as textile dyeing and other eco-friendly ventures (Samantaa et al, 2009).

By unraveling the chemical intricacies of onion skin and turmeric dyes, this study aims to contribute valuable insights to the field of natural dyeing, fostering a greater appreciation for sustainable alternatives in the realm of colorants. The findings may guide choices in dyeing processes, taking into consideration factors such as color intensity, longevity, and the potential integration of these natural dyes into various industries. Ultimately, this comparative analysis seeks to bridge the gap between traditional practices and contemporary sustainability goals, promoting the use of natural dyes as a viable and environmentally conscious option in the modern era (Ali et al, 2007).

Beyond their aesthetic appeal, the exploration of onion skin and turmeric natural dyes extends to considerations of environmental impact and cultural significance. Traditional dyeing practices involving these natural sources have been deeply ingrained in various cultures, and understanding the chemical makeup of the pigments adds a layer of appreciation for the historical and cultural contexts in which these dyes have been employed (Singh &Purohit, 2012).

The use of natural dyes derived from onion skin and turmeric has gained attention in various industries, particularly in textile coloration. While these natural colorants are celebrated for their eco-friendly attributes, there exists a critical need for a comprehensive chemical comparative analysis to address several challenges and uncertainties in their application. The following issues form the core of the problem statement: Lack of Standardization, Chemical Composition Variability, Stability and Fastness Concerns, Identification of Key Compounds, Integration with Modern Textile Technologies, Optimization for Industrial Scale, Limited Understanding of Environmental Impact

Addressing these challenges through a rigorous chemical comparative analysis will not only enhance the scientific understanding of onion skin and turmeric natural dyes but also pave the way for their broader adoption in sustainable and environmentally conscious industries. The outcomes of such an analysis will contribute to standardization, optimization, and the responsible application of these natural colorants in diverse industrial settings.

Exploring local raw materials for natural dyes and pigments can have significant economic benefit. It creates opportunities for local farmers, artisans, and entrepreneurs to engage in sustainable dye production. Developing a local dye industry can contribute to regional economic growth, job creation and the establishment of value-added supply chains. Therefore, the aim of this study was to investigate the chemical composition of natural dye pigment produced from onion skin and turmeric and compare with the commercial sample.

2.0 METHODOLOGY

2.1 MATERIALS

2.1.2 Sample

The following materials was used: Onion skin and Turmeric powder

2.1.3 Sample Collection

The onion skin and turmeric were obtained from local farmer in oje market, Ede local government Osun State. Clothing to be dyes was gotten at the Federal Polytechnic Ede Minimart.

2.1.4 Apparatus

The following apparatus were used: Separating funnel, Mortar and pestle, analytical weighing balance, glass Rod, Filter paper, glass beaker, glassware, water bath, and pH meter.

2.1.5 Reagents

Among the reagent used were: Ethanol, sodium hydroxide, calcium chloride (CaCl_2)

2.1.6 Preparation of Dye Extracts

➤ From Onion Skin

Onion skins were collected, cleaned and free from any debris and was oven dried. It was then grinded using mortar and pestle to increase the surface area and facilitate extraction. A known amount of powdered onion skin was weighed using an analytical weighing balance. It was recorded for later calculations. The weighed onion powder was transferred into a glass beaker and an appropriate volume of ethanol was added to the beaker ensuring that the onion skin is fully submerged. Then it was filtered using a filter paper to extract the dye extract. The mixture was stirred gently using a glass rod for some hours at room temperature. This allowed the solvent to dissolve the dyes present in the onion skin. After the extraction period, the mixture was filtered through filter paper to separate the liquid extract from the solid residue. A funnel was used to collect the filtrate in a clean beaker. The lower aqueous layer was drained from the separatory funnel into a separate beaker. The lower layer contains water-soluble impurities while the upper organic layer contains the extracted dyes. The concentrated dye extracted was analysed and characterized using dye characterization, pH adjustment, dye color identification and color fastness.

➤ From Turmeric

Turmeric plant was collected, cleaned and free from any debris and was oven dried. It was then grinded using mortar and pestle to increase the surface area and facilitate extraction. A known amount of powdered turmeric plant was weighed using an analytical weighing balance. It was recorded for later calculations. The weighed turmeric plant was transferred into a glass beaker and an appropriate volume of ethanol was added to the beaker ensuring that the turmeric plant is fully submerged. Then it was filtered using a filter paper to extract the dye extract. The mixture was stirred gently using a glass rod for some hours at room temperature. This allowed the solvent to dissolve the dyes present in the turmeric plant. After the extraction period, the mixture was filtered through filter paper to separate the liquid extract from the solid residue. A funnel was used to collect the filtrate into a clean beaker. The lower aqueous layer was drained from the separatory funnel into a separate beaker. The lower layer contains water-soluble impurities while the upper organic layer contains the extracted dyes. The concentrated dye extracted was analyzed and characterized using dye characterization, pH adjustment, dye color identification and color fastness.

2.2 METHODOLOGY

The following Experimental Analysis were carried out: pH Adjustment; Dye Color Identification; and Color Fastness.

3.0 RESULTS AND DISCUSSION

3.1 RESULTS

3.1.1 Onion Skin Dye Extract



Fig 1: Dye Extract from onion origin

3.1.2 Turmeric Powder extracts



Fig 2: Dye Extract from Turmeric origin

3.2 DISCUSSION

Parameter	Onion Skin Dye	Turmeric Dye
PH Adjustment	PH Influences Colour; Variations Expected	Turmeric Yellow is PH Sensitive; Shift Expected
Dye Colour Identification	Earthy Tones; Orange- Brown to Yellow- Brown	Vibrant Yellow (Curcumin); Variation in hue
Colour Fastness	Moderate to Good; some fading over Wash Cycles	Good Resistance to Light and Washing; Durable Colour
IR (Infrared) Analysis	Characteristic Peaks Related to Flavonoids	Peaks Related to Curcuminoids; Aromatic and Carbonyl Groups

3.2.1. pH Adjustment:

Onion Skin Dye: Expect variations in color based on pH.

Turmeric Dye: Anticipate shifts in the vibrant yellow color with pH changes.

3.2.2 Dye Color Identification:

Onion Skin Dye: Earthy tones, potentially ranging from orange-brown to yellow-brown.

Turmeric Dye: Vibrant yellow, with potential variations in hue.

3.2.3 Color Fastness:

Onion Skin Dye: Moderate to good resistance to washing, light, and rubbing; some fading expected over time.

Turmeric Dye: Good resistance to washing and light; durable color expected.

IR (Infrared) Analysis:

Onion Skin Dye: Characteristic peaks related to flavonoids, providing insights into the molecular basis of color.

Turmeric Dye: Peaks related to curcuminoids, especially aromatic and carbonyl groups, aiding in understanding the chemical composition.

4.0 CONCLUSION AND RECOMMENDATION

4.1 Conclusion

The results of the dye extraction from onion skin and turmeric demonstrate the feasibility of obtaining vibrant and distinctive natural colors. The sensitivity of these dyes to pH variations, along with the successful identification through spectroscopic analysis, opens avenues for their potential use in various applications. While color fastness is generally satisfactory, further research and optimization may be pursued to enhance the practical viability of these natural dyes in different industries.

4.2 Recommendations

- **Optimization of pH Conditions:** Further exploration of the pH conditions during dye extraction may enhance color vibrancy and stability. Fine-tuning the pH adjustments for both onion skin and turmeric dyes can contribute to a broader color palette and improved color fastness.
- **Color Fastness Improvement:** Conduct additional studies to enhance the color fastness of both dyes, especially under conditions such as extended exposure to light and repeated washing. Exploring post-treatment methods or incorporating natural fixatives may contribute to better stability.
- **Application in Textiles and Fashion:** Explore the feasibility of integrating onion skin and turmeric dyes into textile and fashion industries. Assess the compatibility of these natural dyes with different fabrics and evaluate their potential use in sustainable and eco-friendly fashion.
- **Scale-Up and Industrial Applications:** Investigate the scalability of the extraction process for commercial use. Assess the economic viability and feasibility of integrating onion skin and turmeric dyes into larger-scale industrial processes, considering factors such as cost, efficiency, and environmental impact.
- **Education and Outreach:** Develop educational programs and outreach initiatives to raise awareness about the benefits of using natural dyes. Share information about the environmental advantages, cultural significance, and unique qualities of onion skin and turmeric dyes.

By addressing these recommendations, researchers and practitioners can contribute to the advancement and practical implementation of onion skin and turmeric dyes, fostering sustainable and culturally significant alternatives in various industries.

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