IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Sustainable Cotton Fabric Dyeing Using Marigold Flower Petals (*Tagetes Erecta*) Extract

[1]Vaishnavi Shripat Garde, [2]Dr. Priyanka Pushkaraj Vartak, [3]Shweta Vijay Khopde, [4]Dnyanada Sadanand Ghadi

[1]Student, [2]Assistant Professor, [3]Coordinator, [4]Assistant Professor

[1]Department of Biotechnology,

[1]Sheth L.U.J & Sir M.V College, Mumbai, India

Abstract: The marigold or *Tagetes erecta*, is a popular ornamental plant that is grown for its bright yellow to orange-red flowers. Marigold is used in the textile industry as a natural dye in addition to its visual appeal. The extraction and use of marigold-based dye, as well as an examination of its phytochemical components, are the main topics of this study. An intense yellow color was produced after the dye was successfully extracted. Phytochemicals like flavonoids, carotenoids, steroids, glycosides, phenols, tannins, and terpenoids were detected. Cotton fabric was treated with the extracted dye, and alum was added as a mordant to improve color fixation. The application of alum greatly improved dye stability and longevity on the fabric. These findings highlight the potential of *Tagetes erecta* as an eco-friendly and sustainable source of natural dye for textile industries.

Index Terms - Marigold flower, *Tagetes erecta*, alum, flavonoids, carotenoids, steroids, tannins

I. INTRODUCTION

Marigolds are yellow-blooming flowers. It varies in colour from yellow to orange. The flowers' petals contain natural pigments that can produce a range of hues, from bright yellow to golden orange, when used as a dye (1) (2). Marigold dye is often used for natural fabric dyes, especially in the making of clothing, accessories, and home decor items. Some people use marigold dye in art projects, like dyeing paper or creating natural-colored yarns for knitting and crochet. The color you get from marigold can vary depending on factors like the type of fabric and the mordant used. Marigold flowers contain lutein as natural carotenoid dye along with flavonoids and vitamin C (3).

Most natural colorants are polyphenolic compounds and exhibit low affinity and poor absorption on cotton fabrics(4). Due to the absence of amino and carboxyl groups in its chemical structure, cotton has a limited ability to bind effectively with dye molecules. To address these limitations, mordants were incorporated into the natural dyeing process to help anchor the dye onto or within the textile fibers (7). Therefore, modifying the surface of cotton using natural mordants has been shown to enhance both the fixation and uptake of these colorants on different substrates (5). Traditionally, metal salts such as those of copper, iron, aluminum, and chromium have been used as mordants to aid in binding natural dyes to cotton (6). Here we use a mordant alum for fixing the dye on cotton fabric. The reason to choose the alum as mordent is due to its easy availability, is cheap & poses no harm.

II. MATERIALS & METHODS

MATERIALS :

A total of 24.26 g of fresh marigold (Tagetes erecta) petals were used in the study. Various chemicals were employed for the phytochemical analysis, including chloroform, concentrated sulfuric acid, glacial acetic acid, 0.1% ferric chloride, alcohol, distilled water, 10% sodium hydroxide, and concentrated hydrochloric acid. Standard laboratory glassware such as test tubes, glass stirrers, and beakers were utilized throughout the experiment.

For the dyeing experiments, cotton fabric samples were used as substrates. Alum was applied as a mordant in combination with the marigold flower petal extract to enhance dye fixation. Additional equipment such as strainers, gas burners, a water bath, and a refrigerator were also required for various stages of the procedure.

METHODS :

1.Extraction of dye : A total of 24.26 g fresh marigold (*Tagetes erecta*) petals were collected and put in a beaker containing 100 ml distilled water. The mixture was boiled for half an hour to infuse its color into the water. The extract was cooled and filtered with strainer.

2. Qualitative determination of phytochemical components was carried out in the extracts (7).

a. Test for Steroids: When 2ml of extract was dissolved in 2ml of chloroform and 2ml concentrated sulphuric acid in a test tube on red color produce in the lower chloroform layer indicates the presences of steroids.

b. Glycosides: 0.5 ml of the extract is combined with 2 ml of glacial acetic acid, one 0.1 % ferric chloride drop, 1ml of concentrated sulfuric acid, and thoroughly mixed. The presence of glycosides is indicated by a brown appearance.

c. Test for Phenols: 0.5 ml of extract is taken and a few drops of alcohol and few drops of 0.1 % ferric chloride were added. It is shaken well till the appearance of greenish-yellow color, which indicates the presence of phenol.

d. Test for Tannins : When 0.5ml of the extract is mixed with 20ml of distilled water and it is boiled for sometime and then a few drops of 0.1% ferric chloride were added. It is mixed well till the appearance of brownish-green color which indicates the presence of tannin.

e. Test for Flavonoids : When 0.5ml of extract is mixed with 10% sodium hydroxide, it results in greenish-brown color which indicates the presence of flavonoids.

f. Test for Saponins : 0.5ml of extracts is taken with a small amount of distilled water. The appearance of frothing will indicate the presence of saponin.

g. Test for Quinine : 0.5ml of extract is mixed with a few drops of concentrated hydrochloric acid appearance of green color indicates presence of quinine.

h. Test for Terpenoids : After combining 0.5ml of the extract with 2ml of chloroform, a few drops of strong sulfuric acid are added. The emergence of light orange color indicates the presence of terpenoids.

3. Dyeing the cotton fabric : Immerse the cotton fabric sample in 100 ml of marigold flower petals dye extract and add alum (5.18 g) as mordant. Heat it for 30 minutes, shaking gently to facilitate uniform color absorption. Longer soaking gives a darker color; observe the fabric periodically to view the color transformation. Leave the material to soak in the dye bath for another 2 hours to permit maximum penetration of the dye into the fiber to enable an even coloration. Allow the material to dry overnight after dyeing. Then wash 2 to 3 times in water and mild detergent to check for colorfastness and dye stability (9).

III. RESULTS

A bright yellow color was obtained from the extract of marigold flowers, as shown in Figure 1. Qualitative phytochemical tests were then conducted to determine the presence of various bioactive compounds, as outline in Table 1 below. Marigold flower petal extracts showed the presence of flavonoids, carotenoids, steroids, glycosides, phenols, tannins, and terpenoids, whereas saponins and quinine were absent. After treatment of cotton fabric with marigold flower petals dye extract along with alum, yellow colouration was observed. The

colour did not fade even after 3 washes (Figure 2). This showed that the dye has potential for commercial application, pending further research and process optimization.

IV. DISCUSSION

We got a bright yellow dye from marigold (*Tagetes erecta*) flower petals, just like earlier studies showed. These flowers have a lot of pigments, especially carotenoids like lutein and flavoxanthin (10, 11). This bright color really shows that marigold could be a good natural dye source.

Phytochemical tests showed that there are several active compounds, like flavonoids, carotenoids, steroids, glycosides, phenols, tannins, and terpenoids (see Table 1). These compounds not only give color but also offer some antimicrobial and antioxidant properties, which could make the dyed fabric more useful (12, 13). The lack of saponins and quinine indicates that the extract might not have certain foaming agents and alkaloids, which could help keep the dye strong when used on textiles.

Using marigold dye extract on cotton fabric with alum as a mordant gave a nice stable yellow color. After washing the fabric three times, the color stayed pretty much the same, showing that the dye stuck well and didn't wash out much. This matches earlier studies that show alum works well to help natural dyes stick better and hold up during washing (14, 15).

V. CONCLUSION

The way the color holds up after washing shows that marigold dye could be a great option for textiles, especially since it's eco-friendly compared to synthetic dyes. But for it to be commercially successful, we need to do more research on how to extract it better, what mordants work best, and how well the color lasts with different kinds of light, washing, and rubbing (Gulrajani, 2010). Also, if we want to use it at a larger scale, keeping the dye quality and colors consistent will be really important.

Figures and Tables

Figure 1 : marigold flower petals extract

Figure 2 : dye on fabric sample after washing.

Table 1 phytochemical analysis

TEST	RESULT
Steriods	Positive
Glycosides	Positive
Phenols	Positive
Tannin	Positive
Flavonoids	Positive
Saponin	Negative
Quinine	Negative
Terpenoids	Positive

ACKNOWLEDGMENT

I would like to express my sincere gratitude to my guide, **Dr. Priyanka Pushkaraj Vartak**, for her invaluable mentorship and guidance throughout the course of this research project. I am also thankful to **Mrs. Shweta Vijay Khopde**, Coordinator of the Biotechnology Department, for her support and encouragement. Additionally, I extend my appreciation to **Ms. Dnyanada Sadanand Ghadi** for her assistance and continual support.

REFERENCES

[1] Harlapur, S. F., Harlapur, S., & Harlapur, S. F. (2020). Ecofriendly marigold dye as natural colourant for fabric. In Abiotic Stress in Plants (pp. 1–14). IntechOpen. https://doi.org/10.5772/intechopen.93823

[2] Chandan Kumar Jha, Ratan Kumar, Venkat Kumar S. and Devi Rajeswari V. (2015). Extraction of natural dye from marigold flower (Tageteserectal.) and dyeing of fabric and yarns: A focus on colorimetric analysis and fastness properties. *Der Pharmacia Lettre*, 7 (1):185-195.

[3] Jothi, D. 2008. Extraction of natural dyes from African marigold flower (*Tagetes erecta L.*) for textile coloration. *AUTEX Research Journal* 8: 49–53.

[4] Cuce, M., Kilinc, M., Kilinc, N., Tekin, A., & Kut, D. (2020). Color, Fastness, and Antimicrobial Properties of Wool Fabrics Dyed with *Helichrysum Arenarium* Subsp. *Aucheri* Extract. *Journal of Natural Fibers*, *19*(3), 797–809. https://doi.org/10.1080/15440478.2020.1848706

[5] El-Zawahry, M., Shokry, G., El-Khatib, H. S., & Rashad, H. (2021). Eco-friendly Dyeing Using Hematoxylin Natural Dye for Pretreated Cotton Fabric to Enhance Its Functional Properties. *Egyptian Journal of Chemistry*, *64*(12), 7135-7145. doi: 10.21608/ejchem.2021.82158.4049

[6] Asfandyar Khan, Muhammad Tahir Hussain, Huiyu Jiang. (2018). Dyeing of silk fabric with natural dye from camphor (*Cinnamomum camphora*) plant leaf extract. 134(4), 266-270.

[7] İşmal, Ö. E., and L. Yıldırım. (2019). Metal mordants and biomordants. In *The impact and prospects of green chemistry for textile technology*, ed. I. Shahid ul and B. S. Butola, 57–82. Cambridge: Woodhead Publishing.

[8] P. Ramya*, P. M. Vasanth, P. V. Prasad and V. Sarath Babu. (2019). Qualitative phytochemical screening tests of Alpinia Galanga L. World Journal of Pharmaceutical Research. 8(5), 1064-1077.

[9] Jyoti V. Vastrad, Leela N. Walmiki and Giridhar Goudar. (2017). Dyeing of cotton yarn with marigold (Tagetes erecta) petals: An emphasis on pre-treatments and mordants. *Journal of Applied and Natural Science*. 9 (2): 1276 – 1280.

[10] Saxena, S., & Raja, A. S. M. (2014). Natural dyes: sources, chemistry, application and sustainability issues. In *Roadmap to Sustainable Textiles and Clothing* (pp. 37-80). Springer.

[11] Samanta, A. K., Konar, A., & Singhee, D. (2009). Dyeing of textiles with natural dyes. *Indian Journal of Fibre & Textile Research*, 34(4), 384–399.

[12] Dweck, A. C. (2002). Herbal medicine for the skin. *Pharmaceutical Journal*, 268, 743-748.

[13] Ali, H., Khan, A. A., & Sultana, S. (2011). Natural dyes: their origin, history, and characteristics. *Journal of Textile and Apparel, Technology and Management*, 7(1), 1-12.

[14] Bechtold, T., & Mussak, R. (2009). *Handbook of Natural Colorants*. John Wiley & Sons.

[15] Bhuyan, R., & Saikia, C. N. (2005). Isolation of colour components from native dye-bearing plants in northeastern India. *Bioresource Technology*, 96(3), 363-372.

[16] Gulrajani, M. L. (2010). *Natural Dyes and Their Applications to Textiles*. IIT Delhi.