International Journal of Recent Advances in Multidisciplinary Topics
Volume 4, Issue 9, September 2023
https://www.ijramt.com | ISSN (Online): 2582-7839

Evaluation of the Fastness Properties in Compound Shades of Natural Dyes by Two Extraction Methods

N. A. Vishnu[1*], P. Periyasamy[2], N. Gokarneshan[3], P. Maheswaran[4]
[1]M.Tech. Final Year, Department of Textile Chemistry, SSM College of Engineering, Namakkal, India
[2]Associate Professor, Department of Textile Chemistry, SSM College of Engineering, Namakkal, India
[3]HoD, Department of Textile Chemistry, SSM College of Engineering, Namakkal, India
[4]Assistant Professor, Department of Textile Technology, KSR College of Technology, Namakkal, India

***Abstract*: Clothing and textiles play an important role in human history by keeping infectious and toxic material away from the body. Natural dyes are an eco-friendly dye which are derived from plants and minerals and traced back more than 5000 years. A small variation in the dyeing technique or by use of different mordants with the same dye creates totally new colours. The purpose this project was to evaluate the fastness properties of compound shades of natural dyeing by two extraction method (Aqueous & solvent). This study therefore concerns with the aqoues and solvent extraction of a natural and investigation of factors that influence the colour yield. Natural dyes extracted from different sources from the nature like Curcuma Onga, Lawsonia Inermis. These natural dyes are however non substantive hence their application require the assistance of mordant. The synthetic (alum) and natural mordant(myrobalan) was used for fixation of dyes on the 100%cotton fabric. In this experiment pre & post mordant method is used. For solvent extraction, Soxhlet apparatus used with methanol as a solvent and for aqueous extraction water bath boil is used. The evaluation of colour strength by K/S value and fastness properties such as washing and light fastness were carried out using Spectrophotometer respectively.**

***Keywords*: two extraction method, natural extracts, spectrophotometer.**

1. Introduction

Color is a property by which object has the ability of producing different sensation to the eye due to the way the object reflects or emits light. The dyes were used for coloring food substrates, leather as well as natural protein fibers such as wool, silk, and cellulosic fibers like cotton (Allen; 2000., cordan.,2010). This form of coloring changed in 1856 when William henry Perkin discovered the first synthetic dye called mauveine. The latter being cheap and easier to apply than he natural dyes quickly replaced natural dyes, and found favor in textile industries causing a cultural revolution which resulted in to the commercialization of synthetic dyes(perkin,1856). Most textile dyers and manufacturers therefore shifted towards the use of synthetic colorants because they were cost advantageous, easy to obtain in different grades, types and classes. As a result, this considerably lowered the cost of Natural dyes because the quality of dyeing needed improvement (Taylor, 1989). For many decades, the practice and application of synthetic dyes and colorants expanded as that of natural dyes tremendously declined since the existing natural dyes could not satisfy the demands of the market. Despite their being threatened by the application of synthetic dyes for over a century, the use of natural dyes never eroded away completely. Today, the use of natural dyes in textile dyeing has once again gained interest as an important alternative to synthetic dyed because some of these (Synthetic dyes) have been reported to have carcinogenic effects besides causing environmental pollution (paithoon, 2002.kar et al, 2008). Most of the commercial dyers and textile export firms have therefore started pre examining possibilities maximizing the use of natural dyes in dyeing and printing different textiles while aiming at niche market (cordon 2010) they have also gained economic advantage over synthetic dyes because some are antimicrobial, nontoxic, non-carcinogenic and biodegradable (Sengupta et al,2015: Bhuyan et al,2008: Kamel et al, 2005). On the other hand, synthetic dyes which are widely available at an economic price and produce a wide variety of colors, occasionally cause skin allergy and other harmful effects to the human body as well as embodying undesirable toxicity/chemical hazards accruing from their synthesis, application and life cycle. The effluent generated by this much water pollutes the environment as it contains heavy lots of chemicals including dyes loosed during textile processing, Therefore, two main ways to limit the environmental impact of textile processing is to either construct sufficiently large and highly effective in effluent treatments plants or make use of dyes and chemicals that are environment friendly like natural dyes. The use natural dyes can therefore be a substitute for many hazards synthetic dyes.

2. Materials and Methods

A. Materials

The gray cotton fabric purchased from The Saint fabrics in Amritsar. Synthetic mordant – Alum, Natural mordant –

*Corresponding author: vishnuna60@gmail.com

Myrobalan, Solvent – Ethanol is purchased in the local market. curcuma Longa- Turmeric powder and iawsonia inermis- Henna leaf collected from agriculture farm and neighboring.

B. Methods

The gray fabrics were subjected to the pre-treatment process such as desizing, scouring, bleaching to make it ready for dyeing. The coloring substance that was used in this project work was extracted from henna leaf, turmeric. The above two materials collected and left to shade dry. After dyeing the sample were crushed in to fine powder using an electronic blender stored in a clean container. Apart from the dye and substrate other material that were used included solvents (methanol). The equipment that was used during the experimentation were water bath and Soxhlet apparatus. There are several type of extraction methods, from that two type of extraction method are used for the comparison and evaluating which extraction method which gives good color strength and fastness properties, The extraction method which are specified.

- Aqueous extraction
- Solvent extraction

3. Results and discussion

A. Rubbing Fastness Test- AATCC 8:2005

Evaluation of color fastness to rubbing (dry and wet) was carried out by AATCC 8:2005 crock meter method, (Crock meter consisting of a circular rubbing surface finger measuring 16mm in diameter exerting a downward force of 9N when moving back and for the along a straight-line track of 100mm on the specimen). Standard rubbing cloth is rubbed against the dyed test specimen wih 10 strokes (back and forth) in 10sec (13). Assessment is done by giving the rating for staining as per standard rating scale. (rating 1-5 where 1-poor, 2-fair 3-good, 4-very good, 5-excellent).

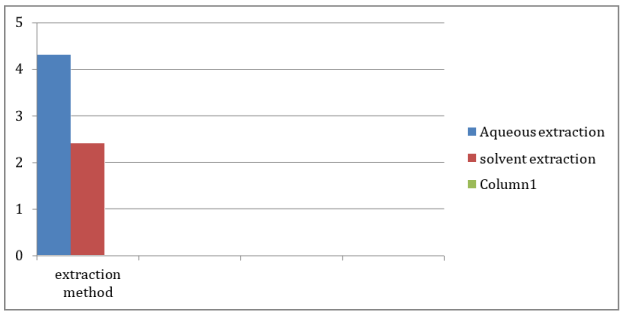

Fig. 1. Rubbing fastness analysis for dyed samples based on extraction method

According to the extraction methods, the rubbing fastness results good in aqueous extraction method compared to the solvent extraction method. There is a color change in the materials when they rubbed by the wet fabric. The solvent extracted samples got sudden color change when rubbed by the wet fabric.

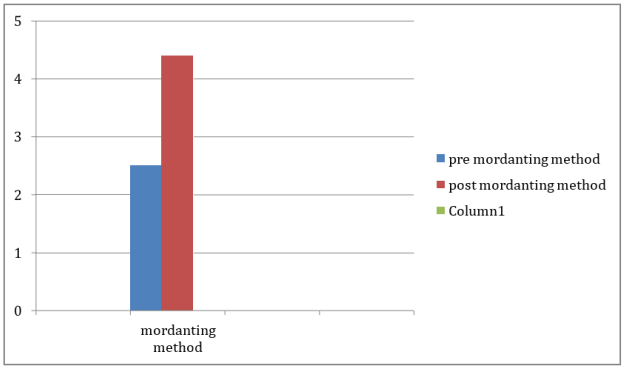

Fig. 2. Rubbing fastness analysis for dyed samples based on mordanting method

Pre mordanting method present the highest measure of fading as compared to post mordanting technique. The fading rate all the fabrics was not so consistent due to the low diffusion of dye of molecules in to the fiber.

Post mordanting had the highest retention of color (Least rate of fading) when cotton fabrics were rubbed by dry fabric. Their value ranges from to post mordanting method produced darker shades for some dyes, whereas colour retention reduced due to the loss of some dye and mordant and due to the dye mordant complex formation in the dye bath. Pre mordanting produces light shades and poor rubbing fastness.

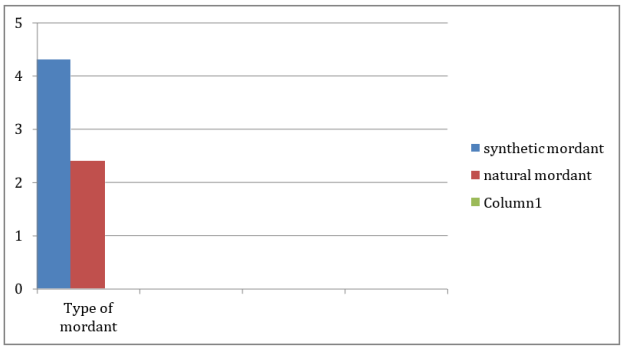

Fig. 3. Rubbing fastness analysis for dyed samples based on synthetic and natural mordant used

Based on the type of mordant, the synthetic mordant results good rubbing fastness than the natural mordant myrobalan. The change in color is very small when rubbing results by the synthetic mordant. The alum gives the more bonding between the color molecules and the material. There is no more color variation in wide range because of the bonding. In the case of natural mordant myrobalan the bonding between the color molecule and the material is poor compared to the synthetic mordant.

Table 1

Methods		**Solvent Extraction**		**Aqueous Extraction**	
Mordant		**Pre-Mordant**	**Post-Mordant**	**Pre-Mordant**	**Post-Mordant**
	Dry rubbing	3	3	3	3
Myrobalan	Wet rubbing	2	2	2	3
	Dry rubbing	3	4	3	4
Alum	Wet rubbing	3	3	3	3

B. Washing fastness- ISO-105-C06

Washing fastness in cotton refers to the ability of cotton fabric or garments to retain their color and overall appearance after being subjected to repeated washing. It is an important quality parameter in textiles, especially for clothing, as it indicates how well the color and durability of the fabric will withstand regular laundering.

Table 2

EXTRACTION		SOLVENT EXTRACTION		AQUEOUS EXTRACTION	
MORDANT		PRE MORDANT	POST MORDANT	PRE MORDANT	POST MORDANT
Myrobalan	Change in shade	2	3	2	3
	Staining cotton	2	3	2	3
Alum	Change in shade	3	4	3	4
	Staining of cotton	3	4	3	4

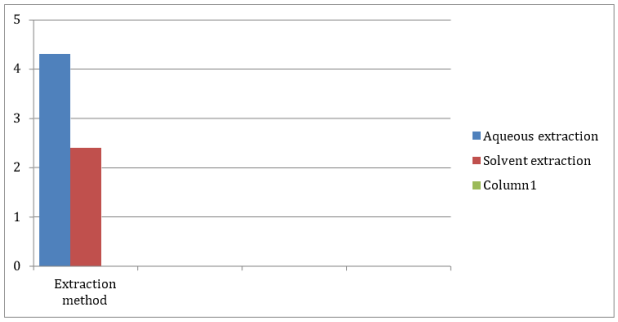

Fig. 4. Washing fastness analysis for dyed samples based on extraction method

In the washing fastness analysis test results that, the aqueous extraction method has good washing fastness than solvent extraction method. The color staining in the materials which are dyed with aqueous extract is results good washing fastness due to small change in the color compared to solvent extraction.

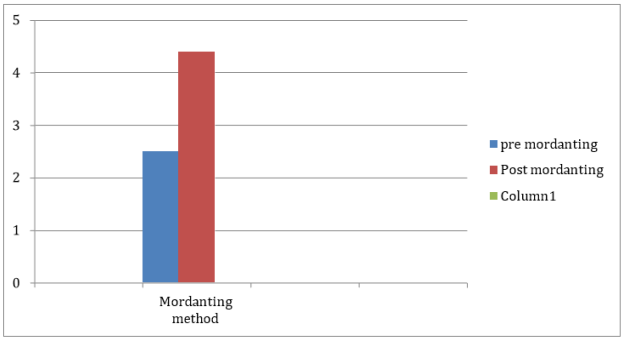

Fig. 5. Washing fastness analysis for dyed samples based on mordanting method

In the basis of mordanting techniques, the good washing fastness results the post mordanting technique. The mordanting after dyeing gives good washing fastness properties due to no more variation in the color of the material. Therefore, color staining of post mordanted material is less compared to pre mordanted material.

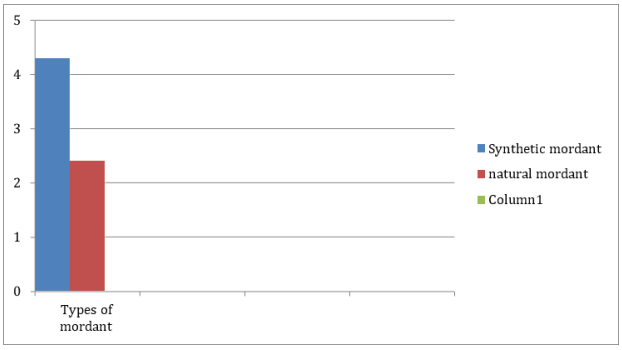

Fig. 6. Washing fastness analysis for dyed samples based on mordant type

According to the type of mordant, the alum synthetic mordant result the good fastness properties. The mordanting with alum gives better washing fastness than natural mordant myrobalan. The color staining is low when synthetic mordanted, because the synthetic mordant have more bonding with the materials.

C. Color Strength Analysis

Color can be defined as the effect on the brain of an observer when an object is viewed in the presence of a light sources.

A computer color matching system comprises of

- Spectrometer
- Personal computer
- Color matching software

Spectrophotometer is an instrument which measures color of an object. The spectrophotometer consists of light source, integrating sphere, dispersion devices, detector, signal processor or microprocessor. Reflectance and k/s value are determined to analyses color strength. Reflectance of the surface of a material is its effectiveness in reflecting radiant energy. It is the fraction of incident electromagnetic power that is reflected at an interface. It is known to us that when reflectance is more, absorbance is less and when reflectance is less, absorbance is more. The color strength of a dye is a measure of its ability to impart color to other material. This property is characterized by the absorption in the visible region of the spectrum and can be expressed as a color strength value. Color strength (k/s) is most important parameter to test the quality measurements of a sample in terms of depth of the color dyed fabric.

Reflectance (%) of the dyed fabric samples were measured by using data color 650TM spectrometer. Strength of any colorant (dye stuff/pigment) is related to absorption property.

Kubelka-Munk Theory gives the following relation between reflectance and absorbance.

$$k/s = [\{(1-R)\ ^2/\ 2R\}]$$

Where ‘R’ is the Reflectance, ‘K’ is absorbance and ‘s’ is the scattering. By using the above equation color strength of different samples were measured.

Table 3

EXTACTIONS METHODS	AQUEOUS EXTACTION				SOLVENT EXTRACTION			
MORDANTS	PRE-MORDANT		POST-MORDANT		PRE MORDANT		POST MORDQNT	
	K/S	RFL	K/S	RFL	K/S	RFL	K/S	RFL
NATURAL MORDANT	**28.551**	**8.848**	**8.272**	**18.620**	**38.227**	**7.036**	**6.928**	**22.455**
SYNTHETIC MORDANT	**36.362**	**6.596**	**48.928**	**5.366**	**24.884**	**8.964**	**39.916**	**6.129**

1) Color strength analysis for shade of lawsonia inermis with curcuma longa

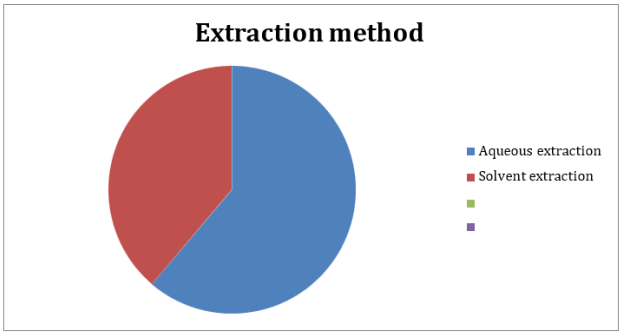

Fig. 7. Color strength analysis of lawsonia inermis on extraction method

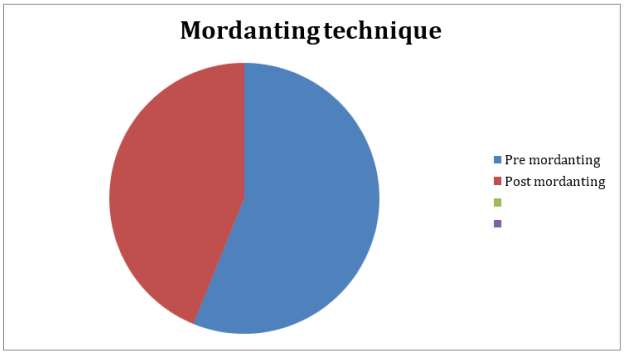

Fig. 8. Color strength analysis for lawsonia inermis on mordanting technique

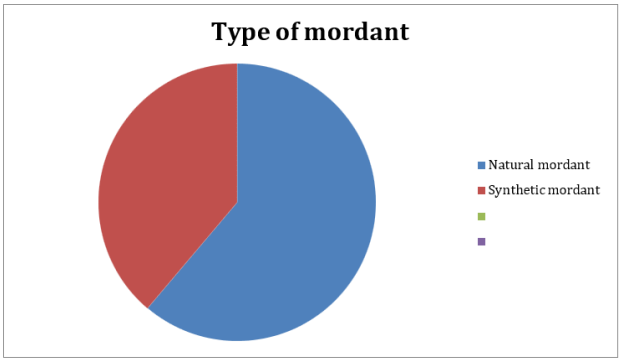

Fig. 9. Color strength analysis of lawsonia inermis on mordanting technique

Analysis of the pie diagram shows that the aqueous extraction method results better color strength than solvent extraction in lawsonia inermis. When compared to post mordanting technique, pre mordanting technique gives better result. Natural mordant myrobolan resulted better color strength than synthetic mordant in lawsonia inermis.

4. Conclusion

The present work was carried out to extract, and analyze the dyeing of cotton substrates using natural dye extracted from lawsonia inermis, curcuma Longa using the aqueous and solvent extraction method. The fabric was mordanted by using natural mordant (Myrobalan) and synthetic mordant (Alum) using pre and post mordanting technique the resultant fabric has been dyed and analyzed for the fastness properties and color strength.

From this study we conclude that, the natural way of mordanting and dyeing is eco-friendly and it is better for human body and health. There are a greater number of ways to improve the performance of natural mordant with the help of natural compounds, that gives better result than the synthetic mordant processing. The post mordanting technique is better compared to the pre mordanting technique. The aqueous extraction method always gives a better result than solvent extraction.

References

[1] SERI 2000 Natural colorants.
[2] Konar A, Samanta A.K. (2011), Dyeing of textiles with natural dyes, India
[3] Kumaresan M, Palanisamy P.N, Kumar P.E(2011). Application of eco-friendly natural dye obtained from flower of spathosea campanulata on silk using the combination of mordants European Journal of Scientific Research,52(3), 306-312.
[4] Pallab K, Barman T. K, Pal T. K., Ramen K. (2013). Estimation of total Flavonoids content (TFC) and Antioxidant Activities of Methanolic whole plant extract of Biophytum Sensitivum linn. Journal of drug Delivery and Therapeutics, 3(4), 33-37.
[5] Pan N.C, Chattopadhyay S.N, Day A. (2003). Dyeing of jute with natural dyes Indian journal of fibre and Textile Research, 28,339-342.
[6] Pan N, C, Chattopadhyay S.N, Day A. (2003). Dyeing of jute with natural dyes. Indian journal of fibre and Textile Research, 28,339-342.
[7] N. Grover and V. Idya Patni. Extraction and application of natural dye preparation from the floral parts of woodfordia fruitcosa (Linn.) Kurz, Indian Journal of Natural Products and Resources, 2(4):403-408, Dec. 2011.
[8] P. N. V. Satyanarayana, Ramesh Chandra. Dyeing of cotton cloth with natural dyes extracted from pomegranate peel and its fastness (International Journal of engineering science and research technology, October 2013
[9] B. Senthil Kumar, V. Karthi and C. Prakash. To study the mordanting method of myrobalan with dyeing of Hibiscus Rosa on cotton fabric, Pramana Research Journal
[10] Sujata Saxena and A. S. M. Raja. Natural Dyes: Sources, Chemistry, Application and Sustainability Issues.
[11] Harbhajan Singh and Kumar Avinash Bharati. Handbook of natural dyeing.
[12] Ezzatollah Muzaffar and Bijan Maleki. Alum mineral and the importance for textile dyeing, Juniper publishers journal of fashion technology and textile engineering, 2018.