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Extraction and Application of Natural Dyes on Natural Fibers: An Eco-Friendly Perspective

Rakhshan Ahsan ^a, Afsheen Masood ^b, Rabiah Sherwani ^c, Hafiza Khushbakht ^d

^a Assistant Professor Home Economics / Ph.D Scholar, Home Economics Clothing & Textile, Punjab University, Lahore, Pakistan

^b Assistant Professor, Department of Applied Psychology, Punjab University, Lahore, Pakistan

^c Lecturer Home Economics, Govt. Fatima Jinnah College for Women, Chuna Mandi, Lahore, Pakistan

^d Lecturer, Royal College of Health Sciences, Bahauddin Zakariya University, Multan, Pakistan

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ABSTRACT

Dyes derived from natural resources like plant leaves, roots, bark, fruits, stem, insect secretions, and minerals were the only dyes available in the history of mankind for dyeing textiles. The first discovery of the synthetic dyes dates back to 1856. Due to the industrialization and globalization, the use of the synthetic dyes has increased in past century. The variety in hue, shades and economic benefits of synthetic dyes have declined gradually and slowly. However, the environmental threats and health hazards to humans have pushed them to the old and natural dyeing resources. Textiles colored with natural dyes are preferred by eco-friendly buyers. Today there is a niche market for such textiles. This paper reviews the available floral, trees, leave, barks, herbs, etc resources, application and extraction of colorants from different natural dyes, and effect of different mordents.

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Corresponding author's email address: rakhshanahsan@gmail.com

1. Introduction

The craft of dyeing is as old as our human progress. The archeological exhuming in regards to colored material has been discovered everywhere throughout the world. This is an open confirmation of old coloring in bygone eras. Natural colors were the main wellsprings of coloring textures, till nineteenth century¹. Since ancient regular colors were generally utilized for nourishment shading, cowhide coloring and common textures coloring like fleece, silk and cotton.² Natural colors can frame huge assortment of tint and shades. They have the inclination of delivering irregular amazing assortment of rich hues that upgrade each other for example furring the bronze age in Europe, the normal coloring systems i.e to adhere plants to texture or scouring squashed shades into cloth³. As the way of life built

up, the procedures were additionally changed and turned out to be further developed. This brought about getting various strategies for regular colors from squashed boiled into the fabrics to improve light and water resistance of the fabrics⁴.

As per the specialists engineered colors are more in the utilization contrasted with the normal colors. Manufactured colors are less expensive and accessible in wide scope of splendid shades. They have nearly better shading speed properties⁵. They are accessible in such huge numbers of assortments and can be applied to normal just as engineered fabrics⁶. However the utilization of manufactured colors causes genuine medical issue and impacts the eco-equalization of nature contrarily. Engineered colors are comprised of synthetic mixes which for the most part contain copper, sodium chloride toluene. Presentation to these synthetic substances can be exceptionally harmful to the human body⁷. Thus the utilization of common dyes are picking up the fame in numerous nations. Besides numerous nations have just forced ramifications on condition models over these colors. Such circumstance, makes a more appeal for the greener and horticultural buildups, as expressed in numerous publications.⁸ The quick and quick interest for eco agreeable condition, presently the majority of the business and material fare houses, are searching for the greatest utilization of the characteristic colors and coloring a printing of material for tending to specialty market.⁹

Common dyes are isolated into 3 classes: the first is from plants for example indigo, the subsequent one is from minerals for example ocher and the third one from verdure. The third classification is accepted to be the nontoxic, non cancer-causing and biodegradable in nature as referenced in such a significant number of articles.¹⁰⁻¹² It is the need of great importance that the common dyes ought to be utilized economically and a fitting and institutionalized coloring strategies ought to be received without determining required nature of colored material materials. Pakistan is a horticultural nation and the foundation of its fare is the nation's material industry. Subsequently it is important to persuade the material proprietors to utilize characteristic dyes to spare the environment.¹³

2. Aim of the Article

The current situation with the craftsmanship article endeavors to give a diagram of common dyes, their sources, extraction and application on filaments and the job of the mordants on normal dye. Accentuation will be paid on their significance when contrasted with engineered colors with no particular goal to dye.

3. Objective of the Study

- To develop understanding regarding application of natural dyes.
- To identify different advantages of natural dyes and their extraction that could guide in future research.
- The effect of mordants on fixing up the color on natural dyes.

4. Definition of Natural Dyes/ Colorants

Natural dyes: - "Regular Dyes" signifies a wide range of colors got from the characteristic sources like: plants, creatures and minerals. Common dyes are delicate and can't be applied on material in that capacity. They need mordents like metallic salt which have the (partiality for both color and the fiber) for application on textiles.¹⁴

5. Process of Natural Dye

The particles of the metallic salt (mordant) ordinarily have a solid planning power. They structure fascination between a frail to medium powers. That is the manner by which they go about as a connecting impetus between normal colors and the fiber to frame generosity. A dye when applied on fiber with more mordants for example metallic salts, encourage the obsession of dye on the fiber; it shapes an insoluble accelerate or lake fumes. This is the manner by which the mordents and the color get fixed on the fiber and become wash quick to a superior level.¹⁵⁻¹⁷

6. Advantages and Disadvantages of Natural Dyes/ Colorants

Because of the growing consciousness about the organic products, the value of eco friendly materials has regained their importance. Same is the case with organic dyes. These days consumer are becoming more aware regarding fibers and textiles. There are some advantages for natural dyes.¹⁸

6.1 Advantages

The shades delivered by normal dyes are generally delicate, radiant and nothing to the human eye.¹ A wide assortment of hues can be made by blend and match framework. A little change in the dyeing methods or variety in the utilization of mordants with a similar dye can make new hues or a wide scope of dye.¹⁹ Very uncommon shading is made by normal dye and simultaneously they are blending. The common dye are sustainable and agro inexhaustible/vegetable based and bio degradable. The loss from the procedure of dyeing turns into a significant compost for farming fields like when utilizing harda, indigo and so on. Numerous dye plants can be developed on squander land. In this way the use of waste land is another value of normal dyes. for example dyes like madder develop can have in tea gardens.²⁰ along these lines joblessness issue can be addressed, since the dye business requires an immense work to develop these normal dye. By the utilization of regular dye the utilization of petroleum derivative can likewise be decreased which is the reason for manufactured dyes.^{1,4} The normal dye are alright for human skin and wellbeing as they are against allergens. Many common dyes e.g myrobolon organic products, turmeric, manjishth root, Arjuna bark, and safflower florets have corrective properties and are being utilized in different customary therapeutic systems.²¹ Some of the characteristic dyes become increasingly appealing and brilliant with age. Though synthetic dyes blur with time. A portion of the normal colors drain yet don't recolor different fabrics for example turmeric. Regular dyes are normally moth confirmation what's more, are generally reasonable for kids pieces of clothing and nourishment stuff for safety.²² In numerous investigates , UV protection qualities of characteristic cellulosic fibers have improved. The dye that is applied to such fabric, brings about improved protection from ultra violet light. In this way regular dye gives an utilitarian advantage to the shopper and the industry.²³⁻²⁵

7. Natural Dyes

7.1 Sources of Natural Dyes

There are various wellsprings of characteristic dyes for example plants, minerals and creature sources. The shading separates from normal sources are captivating and challenges the unit of specialists and researchers. Characteristic dyes are extricated from the roots, stem, and leaves blossoms of different plants like in certain inquires about, strip of onion , turmeric(summongum) onion skin.^{14,26}

7.2 Plant Dyes

Verifiably plants are the most established wellspring of extricating common dyes. Different pieces of the plants incorporate root, leaves, twigs, stems, heart wood, bark, wood shavings, blossoms, natural products, skins, structures, husks and so on. A portion of the normal dyes separated from blossoms are. African marigold, African tulip, Bottle Hollyhock, Saffron, Night blooming jasmine, Aparajita, Flame of the timberland, Yellow flax, Fire Flame Bush, Scarlet Cordia, Cosmos orange are the rich hotspot for characteristic dyes.³

7.3 Animal Dyes

As indicated by the investigation creature colors are gotten from certain minor scale bugs known as Cochineal that bug is benefited from red desert plant berries.²⁷ After that the bug can be accumulated and grounded into pigment. Most important resources of animal dyes are cochineal (red), tyrian purple or crimson from the bodies of marine snails.²⁸

7.4 Mineral Dyes

The normal asset of mineral colors is shaded dirt and earth oxide, chrome green is fundamentally a compound of chromium and oxygen, chrome plated red is a compound of chromium and lead, chrome yellow from a compound of chromic corrosive and lead and Prussian blue from a compound of iron and cyanide.^{28,29} As the writing shows a huge assortment of characteristic colorants are available in nature. These hues are because of the shade present in that specific article and shade of the color is because of chromophores found in color yielding plants.²⁶

8. Application of Natural Dyes on Textiles

Natural dyes are good for dyeing of natural fiber to improve their eco friendly qualities. Natural dyes like synthetic dyes can be used to dye textiles at all stages like fiber, yarn or fabrics. Suitable dyes or natural dyes are resources are chosen according to the color requirement. Only some natural dyes can be applied directly to the textiles but in most of the cases, an additional step mordanting is involved.^{1,26}

9. Mordant

As indicated by the examinations, material fibers, particularly cellulosic normal filaments, don't have a lot of liking for the vast majority of the characteristic dyes. That is the reason another progression in dyeing is included and for example mordanting. Mordants go about as a connection between dye stuff and the fibers. There are some common dyes that have no partiality for filaments particularly cotton and material bringing about more blunt hues, however including mordants, the issue can be tended to and shading speed can be upgraded. In any case, as on account of protein fibers for example fleece and silk, brilliant hues can be come about by the utilization of severe. Thus mordanting is a significant for cotton due to its cellulosic nature when contrasted with fleece and silk.³⁰

9.1 Types of Mordant

- **Metallic mordants** They are mostly metal salts of aluminium, chromium, iron, copper and tin. The metallic mordants are of two types.
- **Brightening mordants** Alum all types of alum, potash alum is cheap and easily available and safe to use. It produces pale effects of natural color dye.
- **Chrome** It is also called red chromate. It is expensive to use and considered to be harmful for human skin, and sensitive to light exposure.

- **Tin** It produces bright color from dye than any other mordant, but produces a stiff hand to the fabric on exposure to air.³¹

9.2 Dulling mordant

Copper (cupric sulphate) It is also known as blue vitriol, easily soluble in water and achieves special effects in shades.

Iron (ferrous sulphate) It is also called as green vitriol and easily soluble in water. It is also used for darkening, browning, and blackening of colors. It is the oldest mordant and mostly used to get grey to black shades.

Tannins The term tanning agent was used for water-soluble cellulosic materials that predigest gelatin from solution. Tannins are polyphenolic compounds capable of gelling under certain conditions, may be in the form of tannic acid or vegetable-tannin-containing substances like robolan, harda, oak galls, sumac, or pomegranate rind. Vegetable tannins are cheaper and collected as excretions from the bark, leaves, fruits, and galls.

Oil type mordant Vegetable oils or Turkey red oil (TRO) are the examples of oil mordants. As a mordant TRO is mainly used in the dyeing of deep red color from madder. TRO is to form a complex with alum when used with alum. Sulphonated oil has a better binding capacity than natural oils. These mordants show a higher color fastness and hues.³²

9.3 Mordanting Methods

Three types of methods for applications of mordant based on the time of their usage

- **Pre mordanting** The mordants are applied to the fabric prior to dyeing. It is useful for cotton and cellulosic as in the unmordanted state they do not have affinity for natural dyes. Even for animal fibers, some natural dyes e.g. cochineal require this type of mordanting process for producing good shades. The advantage of this method is that standing baths can be used for mordanting i.e. the bath can be reused many times after replenishing with the mordants. This makes the process economical as well as it reduces the pollution load hence is useful for large-scale application.³³
- **Post mordanting** In the postmordanting method, the fabric after dyeing is treated with mordant in a separate bath. The final color is developed during the last phase. Iron salts are often applied in this method for producing grey and black colors.^{26,33}
- **Meta or simultaneous mordanting method**, both dyeing and mordanting processes are carried out in the same bath itself. Usually for cotton and cellulose, mordant is also added to the dye bath at the start of dyeing so that both dyeing and mordanting processes take place, in the same bath, at the same time. The dyeing duration is reduced in this method due to reduction in the steps.³³

10. Color Fastness Properties of Natural Dyed Textiles

Shading speed is the draining incapacity of the texture on the other material. The shading speed is typically estimated by loss of profundity in unique shading or by seeping of shading on other material. Shading quickness is estimated by following ways.^{1,2}

10.1 Light Fastness

It was found in the investigation that the colors extricated from bloom petals had poor to medium aftereffects of light quickness. A portion of the mordants treatment could improve the light quickness of characteristic fabrics.^{1,2}

10.2 Wash Fastness

The light speed and wash speed under standard condition 500 C and furthermore at 200C were tried on characteristic fabrics. Some dyes could bring about change in shading on washing as a result of the nearness of modest quantity of alkalie in the washing blends. Subsequently it was discovered that the ph estimation of soluble arrangements ought to be known while cleaning of materials with common dyes^{1,2,34}.

10.3 Rub Fastness

It was found in a study that rub fastness test got to be moderate to good and does not require any particular treatment on natural fabrics dyed from natural dyes.^{1,2}

10.4 Prespiration Fastness

Is only related to apparels.³⁴

11. Different Mordants and Mordanting Methods

Regular dyes require a component to make a connection among fabric and normal dyes. A severe is required to fix the dye to the texture and to build the shading speed. Mordanting can be accomplished at any phase of fiber making, just as any phase of mordanting. Extensive work has been accounted for right now⁴⁷ In the investigation, the aftereffects of biting the dust cotton with tea remove with 5% copper sulfate as stringent and without it, were considered. Pre mordanting was additionally completed. Cotton treated with tea separate in the wake of mordanting demonstrated a noteworthy change in shading richness. Light speed of the considerable number of tests with or without severe was moderate. While astounding washing speed was seen with stringent dyeing.³⁵

Leaves of henna(*Lawsonia inermis*) as a characteristic, removed from plant were utilized as the example for experimentation. The outcomes demonstrated that by including various kinds of mordants, an extraordinary change in shading quality could be observed. It was discovered that the color preparing cost and the Expense for Profluent Treatment Plant (ETP) was additionally lower than other manufactured dyes. The shading quality estimations of silk colored textures were seen as higher than the cotton fabric, regardless of the way that a similar strategy for coloring was utilized for both the fabrics. According to the examination refinement and extraction of common dyes can be of incredible centrality for business and local coloring industries.³⁶ Natural dye separate from *Eclipta Alba* created an extraordinary dye utilized in cotton industry particularly in green, brown and yellow dye. As the color was applied on cotton fabric, different mordants were utilized to fix the dye on cotton. Metal mordants were contrasted and biomordants. The outcomes indicated that sonicator coloring demonstrated 7-9% higher productivity than regular coloring and is increasingly practical, including to the substitution from metal mordants to bio mordants. Thus it was discovered that normal dyeing isn't just eco friendly, bio degradable yet additionally addresses to the removal issue of the dye effluents.²⁶ The tin was considered (as mordant) on concentrate of *Hibiscus rosa sinensis* blossoms, its dyeing fondness on common fabrics. The dye of characteristic bloom brought about delightful shades of red. The best shading, light and washes quickness was acquired with the utilization of mordants on anthocyanin

dyed cotton, fleece and silk fabrics. It could be used as a future dye for article of clothing industry.²⁶ Copper sulfate and alum (as engineered severe) could confer darker shades of yellow shading when contrasted with the regular stringent (aloe vera and lemon) on cotton texture dyed from onion skin. Thus it was found in the investigation, that onion skin dye with engineered severe under post mordanting system gave the best aftereffects of colorfastness.¹⁴ The two extraction procedure of removing normal dye from beetroot and turmeric were taken as an investigation objective. It was discovered that MAE is increasingly effective procedure when contrasted with regular method. It requires lesser vitality utilization with high concentrate quality.³⁹ Another strategy named ultrasound saw as more ecofriendly to extricate common dyes from different pieces of the plants was considered by the analyst as Carrot was utilized as a characteristic dye asset and it was tried on silk fabric. Mordants were likewise utilized and shading quickness was gotten from this dye.³⁷

Because of worldwide condition mindfulness, another study was concluded in 2013 to examine the various parts of normal dyes in order to restore the developing enthusiasm on the use of regular dyes on characteristic filaments. The outcomes demonstrated that by the utilization of regular severe, chitosan, on characteristic dyed cotton texture from *Eisenia bicyclis* was seen as better in shading quality, UV security when contrasted with the undyed cotton fabric.³⁸ The impact of jug brush bloom separate as a characteristic dyer on cotton texture was studied. It was presumed that with the utilization of mordants on cotton texture with normal dye, bringing about great shading fastness.⁴⁸ In another examination it was discovered common dyes had consistently been being used on little scale textiles. The most significant preferred position of characteristic colors is the probability of misusing the shade dyes containing flora. It has no hurtful impact on the eco and sea-going fauna and greenery by wastewater discharge.⁴⁹ In an exploration, the accessible botanical dye assets, application and extraction of dyes from blossoms and impacts of various mordants were reviewed. It was finished up from the investigation that the manufactured dyes effectually affect condition furthermore, because of the greener and eco inviting target, much mindfulness has created among nations, specialists and material associations, with the time.³ Natural dyes show non harmful, non hypersensitive effects and results in less contamination. Presently it has become a rich field of research in materials dyeing. Normal dye assets are enhanced with various greenery qualities.^{2,3,43} In an examination, unadulterated cotton and fleece yarns were dyed with regular dye separated from mari gold flower, in the nearness of various mordants. The study uncovered that entire procedure is ecofriendly and mari gold blossom could be a helpful wellspring of natural dye to material industry. Variety of tints and shades can be gotten utilizing eco agreeable and safe mordants. The analysts have reported that normal dyes could be similarly practically identical with engineered dyes.⁴⁰ A broad investigation was directed to address the issues in regards to contamination and wellbeing dangers because of unnecessary utilization of manufactured dyes, the regular dyes are picking up the fame once more. The fundamental thought of separating dyes from normal sources is to build the life of universe. Common dyes could be applied on cotton fabrics. Various mordants were utilized to fix the shading on common textures. Dyes were extricated from peacock bloom, beet root, onion skin, red cabbage, *Bongainvillea* and papaya leaf. It could be remarked that regular dyes could be utilized for dyeing eco inviting materials in an assortment of alleviating, phenomenal and glistening shades with eco agreeable mordants and completing agents.⁵⁰ The extraction of common dye from petals of *chrysanthemum* blossom and strip of badam organic product was done in an examination and it was applied on cotton and silk, to check the dyeing effectiveness with or without mordants. The hues that were gotten were dull purple, red and pink. It was presumed that the characteristic dyer from the previously mentioned assets could be a decent normal dye. They showed strong color fastness after washing tests were carried out.⁴²

It was found in an investigation that the generation and utilization of normal dyes ought to be expanded due to its quick request in dyeing material industry for some great reasons. The specialists looked into hundred dye yielding plants, species and parts which could be utilized for regular dye extracts. Hence it could be expressed that it is critical to save significant plant assets for common dyes with legitimate logical methodology, and headway in biotechnological fields to improve the quality and amount of dye creating plants.⁵¹ The job of mordants for obsession of characteristic dye (pomegranate and mari gold concentrate) on cotton and synthetic fabric has been accounted for in the examination. The metal salts were utilized, bringing about better shading strength. The Ferrous Sulfate, copper sulfate and alum used to build the connection between the fiber and the dye bringing about high dye up take. Hence it was presumed that the world is presently focussing on expanded use of characteristic dyes and shading dyes in nourishment, materials and pharmaceuticals instead of engineered opponents, aiming on better wellbeing, eco-accommodating condition and drawing out life on earth.⁴¹ An endeavor was made to separate regular dyes from rhizome of turmeric, fruits of harda, petals of safflower, and underlying foundations of barberry utilizing explicit systems. These dyes were applied on cotton, fleece and silk. The coloring systems and sort of mordants saw as significant for the aftereffects of shading on common fabrics. The best outcomes were found on silk then fleece and the keep going on cotton. The methods of extraction of regular dyes saw as cost productive and reasonable great measure of color could be achieved.⁴³

Another study was conducted on bamboo yarns dyed from pitaya peel and turmeric. It was discovered that bamboo yarns had fine retentiveness for regular dyes. The pace of assimilation of dye could be expanded with dye focus yet up to the specific degree of saturation. In short it could be expressed that normal colors are more eco-friendly, safe to people and innocuous in each regard and ought to be utilized positively.⁴⁴ Calligonum comosum plant was utilized as an example to separate common dye and afterward applied on cotton fabric under various conditions. The results showed that cotton texture dyed from Calligonum had expanded defensive capacities against ultra violet beams, of the fabric. This study could be an extraordinary assistance for dermatologists, encouraging patients to utilize attire produced using characteristic filaments and dyed with normal colorants having UV insurance qualities.²¹ A study was led in (2015) on normal color got from Acacia Catehu and was applied on cotton weaved fabrics. It was inferred that that by utilizing institutionalized normal dye, great shading quality and coloring properties can be accomplished. The colored mercerised cotton weave textures indicated higher shading quality when contrasted with scoured sew cotton fabric.⁴⁵ A test study was completed, which tended to with various techniques for dyeing, by removing a characteristic dye from marigold blossom petals, on cotton fabrics. It was seen that TDS consequences of ultrasonic procedure were more eco well disposed than exhaust dyeing. The washing and light quickness of dyed cotton fabrics were nearly acceptable.⁹ It was found in another investigation that there was a distinction in shrinkage properties, when extricate from normal color henna and skin of onion was applied on 100% cotton, 100% polyester and 35% cotton 65% polyester fabrics. 100% cotton fabric demonstrated the most elevated outcome for shading speed. Great outcomes were appeared for light and wash speed for all %ages of both the dyed fabrics. But low results were shown for acid and alkaline perspiration fastness.⁴⁶

It was remarked by the scientist in an exploration that huge scope of shades could be gotten by changing mordants proportion and blends. Similarly they led their investigation on fleece and various blends of mordants for example lemon juice CuSO_4 , lemon juice $\text{K}_2\text{Cr}_2\text{O}_7$, lemon FeSO_4 , and lemon juice SnCl_3 alongside three unique methods of mordants application. The washing, scouring, light and sweat

quickness of dyed textures were watched. The outcomes that were accomplished were reasonable for astounding evaluations in all tests.⁴⁷ In another investigation various parts of characteristic dyes were engaged. It was presumed that progressively precise examination must be done on all the procedures of normal dyes assets in order to advance eco inviting textiles.⁵² It was seen in an investigation that the treatment with tannins during itself improved the UV assurance of fabrics.⁵³ In another exploration, it was likewise being seen that concentrates of tannin-rich pomegranate skin brought about solid ingestion in UV district and cotton fibers treated with these concentrates demonstrated incredible UV security which was strong to washing.^{1,2} Many of the characteristic dye have antimicrobial properties.⁵³ Users of regular dyed fibers have additionally mosquito repellent and fire resistant properties.^{22,60} According to the exploration, common plant dyes should be the better decision contrasted with manufactured dyes in materials kicking the bucket business. The overview look into was directed in Ashanti, city of Ghana, to address the goals. It was reasoned that throughout the years a few types of plants were utilized for regular extraction, however on the expanding request, it was important to build the wellsprings of the common dyes.⁵⁴ Another examination was directed, on characteristic dyes, removed from hibiscus, espresso, annatto, turmeric, acai berry to replace synthetic dyes on cotton fabrics. Two methods of extraction were compared. It was suggested that in general, to improve the performance of natural dyes on cotton the extraction conditions most favorably, in alkaline medium above 40 °C.⁵³

It was found in the examination expecting to research, texture designs configuration by tie and dye strategy utilizing regular dyes. Four examples of tie and dye procedure that were tying, collapsing, creasing, wrapping, squeezing and sewing were utilized to make wonderful examples on scarves. Four normal dyes from sappanwood, red cabbage, basil and mango were used. The result was imaginative, conservative and eco friendly.⁵⁵ This study concentrated on the extraction of characteristic dyes from *Curcuma longa* (turmeric), *Allium*, *Optunia ficus-indica*, *Beta vulgaris*, *Hibiscus*, *Lwasonia inermis*. In the strategy, the plant dye was changed over into the glue, dried and FR-IR Spectroscopy was applied to recoup dye in an unadulterated powder form.⁵⁶ It was accounted for in the investigation that regular dye extricated from *A. coriaria* (bark), *M. lucida* (bark & roots), *S. cordatum* (bark) and *V. paradoxa* (bark) could be extremely gainful dye yielding plants for regular dyes in material industry improvement. The shading and light quickness properties were reasonable for the utilization in the material business. Various mordants could be utilized for dye adequacy on natural fibers.⁵⁷

In another article, the availability, extraction, and the application of natural dyes were reviewed. Different types of indigenous plants produce natural dyes in Indonesia. It was found that the use of natural dyes should be increased to address the global problem of pollution. The government plays a vital role in promoting such environmental friendly policies.⁵³ A study was conducted on global communities, biotechnology and sustainable design and the use of bio/natural dyes in textiles industry. The job of biotechnology in supplanting old mechanical techniques with eco agreeable farming strategies, the principle improvement in expanding development of types of plants utilized in the assembling of filaments or their properties, generation of new sorts of strands, various kinds of dyes, effluents 'the board, among others. It is the need of the day to advance broad utilization of biomaterials in items and style articles of clothing. That will add to the reasonable plans, economical procedure and prosperity improvement. Similarly, the characteristic dyes are more eco well disposed and more secure for human wellbeing. The regular dyeing mixes are progressively biodegradable and safer.⁵⁸

A study was experimented on tamarind seed coat as tannin employed as a natural mordant and

in combination with metal mordant applied on cotton, silk and wool fabrics dyed naturally with turmeric and pomegranate. The natural fabrics treated with tannin produced good antibacterial activity. The only limitations attached to it was the unsatisfactory wash durability after five washes. The wash and light fastness properties of the dyeing on fabrics were found to be enhanced when mordanting was done.⁵⁹

In another research two different types of tamarind seed dye were applied on cotton, bombyx silk and Eri silk fabrics. The three different mordants were applied on the dyed fabrics. The ZnSO_4 mordant applied fabrics resulted in better color fastness after washing without causing change in shade. $\text{K}_2\text{Cr}_2\text{O}_7$ mordant could help to stabilize the dye molecule with shade alteration and washing fastness. FeSO_4 mordant might form shade change on the dyed fabrics adding excellent color fastness to washing. It was documented in a study that natural dyes extracted from the leaves and stems of Schum from ultra sound method and applied on silk by adding and subtracting mordants. In the study a profound effect of mordant was noticed on silk fabric with better color fastness.⁶¹

12. Conclusion

It has been concluded that natural dyes are better to be used in textile industry in comparison with synthetic dyes because of so many reasons. There are still a lot of natural resources of natural dyes which are untouched. Despite the fact that natural coloration is known to history from ancient civilizations. Now again as the time has changed and due to the eco friendly nature of natural dyes, they are promoted by major textile industries and developed countries. Thus there are needs of active researchers in the development of natural dyes industry. A lot of knowledge and data base is required to make natural dyes popular in the textile industry. There are two dependent factors (dye and mordant) that effect the color stability of natural dyes in textiles. Mordant always plays a very important role in developing good natural dyes on natural fabrics. The three methods pre simultaneous and post mordanting are equally important, as the color depends not only on natural colorants but also on the mordant and mordanting assistants used. The quality of color of natural dyes are measured by fastness properties. With the use of mordants, the natural dyes efficiency is increased. Natural dyes are obtained from renewable resources. These are biodegradable and the residual vegetal matter left after extraction of dyes that can be easily composted and used as fertilizer.

References

- Saxena S, Raja AS. Natural dyes: sources, chemistry, application and sustainability issues. In Roadmap to sustainable textiles and clothing 2014 (pp. 37-80). Springer Singapore.
- Samanta AK, Agarwal P. Application of natural dyes on textiles.
- Singh R, Srivastava S. Exploration of flower based natural dyes—a review. Research Journal of Recent Sciences. 2015; 4:6-8.
- Practical Action, Dyeing of Textiles, a technical brief, The Schumacher Centre for Technology and Development,.
- Mirjalili M, Nazarpour K, Karimi L. Eco-friendly dyeing of wool using natural dye from weld as co-partner with synthetic dye. Journal of Cleaner Production. 2011 Jul 31;19(9):1045-51.
- Samanta A K, Agarwal Priti & Datta Siddhartha, Indian J Fiber Text Res, 33(3) (2008)
- Purwar S. Application of natural dye on synthetic fabrics: A review.
- Samanta AK, Konar A, Dyeing of Textiles with Natural Dyes: A review, Indian Journal of fiber and textile research, 2009
- Baig, U., Khatri, A., & Ali, S. Environmentally Sustainable Natural Dyeing of Cotton Fabrics Using

Ultrasonic Technology.2016

- Bechtold,S.A, Chatterjee S, Chatterjee BP, Guha AK. Adsorptive removal of congo red, a carcinogenic textile dye by chitosan hydrobeads: Binding mechanism, equilibrium and kinetics. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*. 2007 May 15; 299(1):146-52.
- Bhuyan R, Saikia CN. Isolation of colour components from native dye-bearing plants in northeastern India. *Bioresource technology*. 2005 Feb 28;96(3):363-72.
- de Lima RO, Bazo AP, Salvadori DM, Rech CM, de Palma Oliveira D, de Aragão Umbuzeiro G. Mutagenic and carcinogenic potential of a textile azo dye processing plant effluent that impacts a drinking water source. *Mutation Research/Genetic Toxicology and Environmental Mutagenesis*. 2007 Jan 10;626(1):53-60.
- Holme.I, Technical Textiles
- Zubairu A, Mshelia YM. Effects of Selected Mordants on the Application of Natural Dye from Onion Skin (*Allium cepa*). *Science and Technology*. 2015;5(2):26-32.
- Agarwal A, Goel A & Gupta K C, *Textile Dyers and Printer*, 25(10), (1992), 28
- Agarwal A, Garg A & Gupta K C, *Colourage*, 39(10) (1992) 43.
- Agarwal A, Paul S and Gupta K C , *Indian Text J*, (1) (1993) 110.
- Ado A, Yahaya H, Kwalli AA, Abdulkadir RS. Dyeing of textiles with eco-friendly natural dyes: a review. *Int J Environ Monit Assess*. 2014;1(5):76-81.
- Ali S, Hussain T, Nawaz R. Optimization of alkaline extraction of natural dye from Henna leaves and its dyeing on cotton by exhaust method. *Journal of cleaner production*. 2009 Jan 31;17(1):61-6.
- Bhattacharyya N. Natural dyes for textiles and their eco-friendly applications. *IAFL Publications*; 2010.
- El-Amoudy ES, El-Ebissy AA. Optical studies of cotton fabrics dyed with a natural dye. *British Journal of Applied Science & Technology*. 2015;9(2):159-71.
- Basak S, Samanta KK, Arputhraj A, Saxena S, Mahangade R, Narkar R(2012) Method of dyeing and protective finishing of cotton textiles using vegetable extract. *Indian Patent Application no 3469/MUM/2012*
- Chattopadhyay SN, Pan NC, Roy AK, Saxena S, Khan A. Development of natural dyed jute fabric with improved colour yield and UV protection characteristics. *Journal of the Textile Institute*. 2013 Aug 1;104(8):808-18.
- Katarzyna SP, Kowalinski J. Light fastness properties and UV protection factor of naturally dyed linen, hemp and silk. In *Proceedings, flaxbast 2008: international conference on flax and other bast PLANTS*, Saskatoon, Canada. Accessed 2008 Jul (pp. 21-23).
- Sarkar AK. An evaluation of UV protection imparted by cotton fabrics dyed with natural colorants. *BMC dermatology*. 2004 Oct 27;4(1):15.
- Vankar PS. *Handbook on Natural Dyes for Industrial Applications (Extraction of Dyestuff from Flowers, Leaves, Vegetables)*.
- Irobechni, Analytical methods for the characterization of organic dyes in art work and in historical textile, *Appl spectrosc rev*, 44, 2009, 365-410.
- Alemayehu T, Tassew, Teklemariam Z. RESEARCH-GRANTHAALAYAH.
- Rosenberg E. Characterisation of historical organic dyestuffs by liquid chromatography-mass spectrometry. *Analytical and bioanalytical Chemistry*. 2008 May 1;391(1):33-57.
- Shahid M, Mohammad F. Recent advancements in natural dye applications: a review. *Journal of Cleaner Production*. 2013 Aug 15;53:310-31.
- Melo MJ. History of natural dyes in the ancient mediterranean world. *Handbook of natural colorants*. 2009 Apr 6:3-20.
- M. Shahid, A. Ahmad, M. Yusuf, M.I. Khan, S.A. Khan, N. Manzoor et al., *Dyes Pigments*. 95(1), 53-61

(2012)

- Bechtold T, Mussak R, editors. Handbook of natural colorants. John Wiley & Sons; 2009 Apr 6.
- Goetz C. Textile dyes: techniques and their effects on the environment with a recommendation for dyers concerning the green effect.
- Kaur V, Chattopadhyay DP, Kaur S. Studies on the Effect of Mordants on Dyeing Behaviour of Bamboo Fibres using Natural Dyes. International Journal of Engineering Innovations and Research. 2014 Sep 1;3(5):666.
- Hasan MM, Abu Nayem K, Anwarul Azim AY, Ghosh NC. Application of Purified lawsone as natural dye on cotton and silk fabric. Journal of Textiles. 2015 Apr 15;2015.
- Almahy, H. A., Ali, M. A., & Band Ali, A. A. (2013). Extraction of carotenoids as natural dyes from the *Daucus carota* Linn (carrot) using ultrasound in Kingdom of Saudi Arabia. Res. J. Chem. Sci, 3(1), 63-66..
- Ángeles BM, BOU E, MONTAVA I, DIAZ P. DYEING COTTON WITH EISENIA BICYCLIS AS NATURAL DYE USING DIFFERENT BIOMORDANTS.
- Summoogum-Utchanah SL, Joyram H. AN INVESTIGATION ON THE POTENTIAL OF EXTRACTING NATURAL DYES FROM BEETROOT AND TURMERIC.
- Chandan Kumar Jha, Ratan Kumar, Venkat Kumar S. and Devi Rajeswari V. Extraction of natural dye from marigold flower (*Tagetes erecta*.) And dyeing of fabric and yarns: A focus on colorimetric analysis and fastness properties .Scholars Research Library.Der Pharmacia Letter, 2015, 7 (1):185-195.
- Tripathi G. Yadav, M. K., Upadhyay, P. Mishra S. Natural dyes with future aspects in dyeing of Textiles: A research article.2015.
- Merina Paul Das, R.Priyanka, A.M. Rafeeqe, K.Sivagami. Eco Safe Textile Coloration Using Natural Dye Int.J. Pharma. Sci.Rev.Res. 39(1) July 2016 Article No.32, pages: 163-166.
- Arora J, Agarwal P, Gupta G. Rainbow of Natural Dyes on Textiles Using Plants: Friendly Processes. Green and Sustainable Chemistry. 2017;7(01):35.
- Logapriya L. Adsorption of natural dye on bamboo yarn.
- Selvadass, M. (2015). Process Analysis and Optimization of Dyeing Fabric with Standardised Natural dye obtained from *Acacia Catechu*. International Journal of Green Chemistry and Bioprocess 2015; 5(2):5-13.
- Owis AS. An economical dyeing process for cotton, polyester and cotton/polyester blended fabrics. Journal of Textile and Apparel, Technology and Management. 2010 Aug 30;6(4).
- Singh SV, Purohit MC. Applications of Eco-Friendly Natural Dye on Wool Fibers Using Combination of Natural and Chemical Mordants. Universal Journal of Environmental Research & Technology. 2012 Apr 1;2(2).
- Baishya D, Talukdar J, Sandhya S. Cotton Dying with Natural Dye Extracted from Flower of Bottlebrush (*Callistemon citrinus*). Universal Journal of Environmental Research & Technology. 2012 Oct 1;2(5).
- Atodiresei GV. BOTANICAL RESOURCES OF SPONTANEOUS AND CULTIVATED FLORA, WITH APPLICATIONS IN THE COSMETICS INDUSTRY. Agronomy Series of Scientific Research/Lucrari Stiintifice Seria Agronomie. 2011 Jun 1;54(1).
- Geetha B and V Judia Harriet Sumathy. International Journal of Chemistry and Pharmaceutical Sciences. IJCPS, 2013:Vol.1 (8):502-509.
- Bhuvaneshwari R. Senthilkumar R.P. S.Sathiyavimal R.Amsaveni, Malayaman. Natural Colours from Dyeing Plants for Textiles.International Journal of Biosciences and Nanosciences
- Alemayehu, T. Teklemariam, Z. RESEARCH-GRANTHAALAYAH.

- Viana TC, Pagnan CS, Ayres E. Natural dyes in the design of textile: how to make them more competitive face to synthetic dyes. JAIC-Journal of the International Colour Association. 2015 Apr 27;14.
- Acquah SB, Oduro KA. Traditional cloth dyeing enterprise at Ntonso: Challenges and opportunities. West African Journal of Applied Ecology. 2012;20(1):25-36.
- Mayusoh C. The art of designing, fabric pattern by tie-dyeing with natural dyes. Procedia-Social and Behavioral Sciences. 2015 Jul 25;197:1472-80.
- Priyadharsini P, David ST. NATURAL DYES AND THEIR FT-IR SPECTROSCOPY STUDIES. International Journal on Applied Bioengineering. 2014 Jan 1;8(2).
- Wanyama PA, Kiremire BT, Murumu JE. Extraction, characterization and application of natural dyes from selected plants in Uganda for dyeing of cotton fabrics. African Journal of Plant Science. 2014 Apr 30;8(4):185-95.
- Carvalho C, Santos G. Global Communities, Biotechnology and Sustainable Design–Natural/Bio Dyes in Textiles. Procedia Manufacturing. 2015 Jan 1;3:6557-64.
- Prabhu KH, Teli MD. Eco-dyeing using Tamarindus indica L. seed coat tannin as a natural mordant for textiles with antibacterial activity. Journal of Saudi Chemical Society. 2014 Dec 31;18(6):864-72.
- Tepparin S, Sae-be P, Suesat J, Chumrum S, Hongmeng W. Dyeing of cotton, bombyx mori and eri silk fabrics with the natural dye extracted from tamarind seed. International Journal of Bioscience, Biochemistry and Bioinformatics. 2012 May 1;2(3):159.
- Wang C, Xu C, Tian A, Fu S, Wang C. Extraction of natural dyes from Alpinia blepharocalyx K. Schum. for dyeing of silk fabric. Coloration Technology. 2013 Feb 1;129(1):32-8.