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Various Uses of Natural Plants Extracts for Functionalization Textile Based Materials

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THE use of natural colors creates no problems for waste disposal and can provide naturally dyed fabrics. Dyes may be derived from natural resources since old times. And The revival of sustainable plant-based dyes now a day is becoming the demand for the global community in all fields.so in this review, we discuss the application of natural plant extracts such as peanutpod which usedin the dyeing of cotton fabric and using olive tree leaves and its extraction to dye cotton fabric and dyeing wool using henna extraction with the use of chitosan pretreatment instead of mordanting and also extract new natural mordant from oak and uses it In the dyeing of wool fabric.

Keywords: Natural plants; wool; cotton fabrics; natural dyeing; mordant; ecofriendly.

Introduction

Dyes are commonly used intextile, paper, cosmetic, fruit, medicinal, and leather industries. One of the main problems of the world's environment is water contamination caused by the discharge of color-free nonbiodegradable effluents from garment dye manufacture and the textile dyeing process.**[1]**

Natural colors were only used to color textiles from ancient times to the 19th century on many occasions. Due to its biodegradability, low toxicity and UV ingredients, natural dyes are often environmental-friendly than synthetic dyes. **[2-5]**

Dyeing is an old craft that predates written documents. its practice can be traced back To the Bronze Age in Europe. Primitive methods of dyeing involved sticking plants to the cotton to make or rubbing crushed pigments.**[6]** The process was enhanced with time and techniques using natural dyes from crushed grapes, berries, and other plant materials boiling into the tissue while some light and water fastness (resistance) tests were developed.**[7, 8]**

The demand for synthetic dyes with natural dyes is very low. But the use of natural dyes can be wide. It Can be used in fruit, leather, printing ink, plastics, mobilization, natural fiber (cotton, wool, silk, ramie, etc.). **[2, 8, 9]**

Textiles were traditionally colored with materials available in nature. Nature has gifted several dyes yielding plant species, animals, and minerals for the dyeing and coloring of raw materials. natural coloring agents come from different plant sections such as leaves, fruits, stems, barks, etc.**[7, 10-14]**

Unlike synthetic dyes, natural dyes from plants, and other sources might contain more than one chemical component, each with different colors and properties, which operate separately or together, depending on their functional group (chemical composition and structure). **[10]**

The textile and dyeing industries are one of

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the most important in several nations. Due to the environmental protection of the region, natural dyes are extremely important in the dyeing process. To ensure the yarn is green, pure, and environmentally friendly.**[15, 16]**

The discharge that is produced after its use or synthesis not only destroys the health of the world but also increases global warming that causes the disruption of agricultural land, bodies of water, and human health. People around the world are now exploring the development of green goods including natural dyes in any area. **[16]**

Most natural dyes often have beneficial properties and can be used to tease and finish textiles at the same time. A study from researchers is also the search for new sources of natural dyes. **[17-22]**

The use of mordants and post-treats to improve color rapidity is another important factor. However, the most sustainable way to dye fabrics does not chemically change the natural dyes, so the dyeing bath will eventually be released without risking any damage to the environment. This excludes the use of several mordants since also metal salts are contained.**[9, 19, 23-26]**

Definition of natural dyes/colorants

The term "natural dyes" includes all-natural sources such as plants, animals, and minerals. Natural dyes are largely non-substantial and must be added on textiles with the help of mordants, typically metallic salt, which has an affinity for both the coloring matter and the fiber. Metal transition ions normally have high coordinating power and/or can form attraction/ interaction powers and thus can act as bridge material to provide the substantivity for natural dyes/colorants by impregnating the fiber with a metallic salt. (i.e. mordanted) is subjected to dye with various dyes, typically with a certain mordant group that makes it easier to attach such dye/colorant.

These metallic mordants create an insoluble precipitate or lake after combined with the dye in fiber, and the color and mordant are fixed to become wash fast to a reasonable level. **[11]**

Occasionally, natural dyes are often considered to be positive, as "natural" sounds are environmentally friendly; sometimes negative, as they are less reliable than synthetic. The main sources of natural colorants are shown in **Fig. 1**.**[9]**

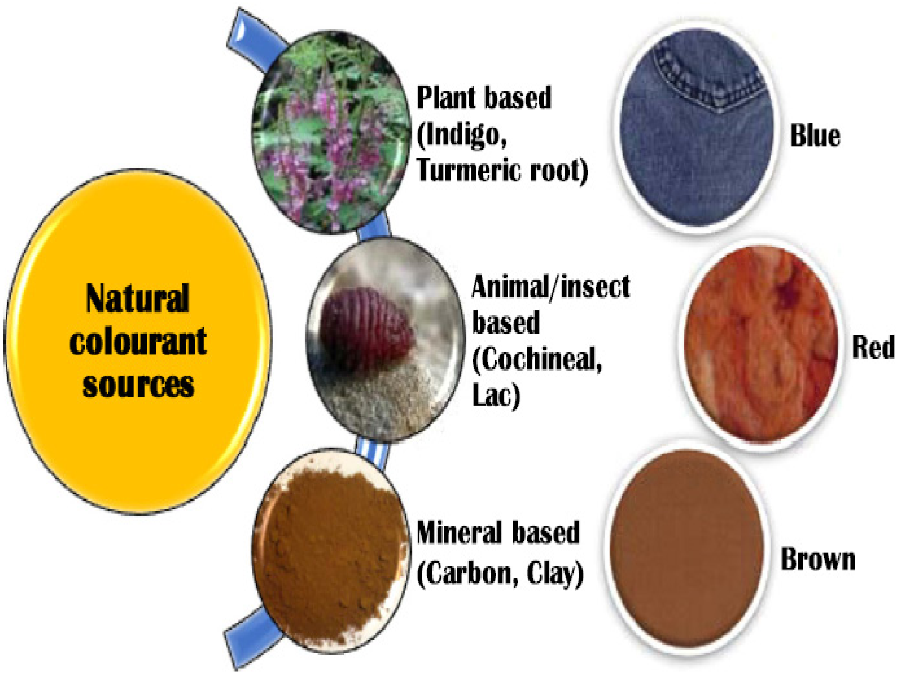


Fig. 1. The main sources of natural colorants.

Advantages of natural dyes/colorants

In the last few years, the process of natural dyeing has been revived. This is partly because natural colors are beneficial than synthetic colors in certain aspects. Some of these benefits are listed below:-

The shades created by natural coloring materials are generally soft, brilliant, and human-eye soothing.[6, 10]

The natural colors, through a mixing and matching system, will create a wide range of colors. A little difference in the dyeing process or using various mordants of the same dye (polygenetic type of natural dye) will change colors, or produce completely new colors.[12]

In certain situations, such as harda, indigo, etc., the waste in the process is an excellent fertilizer for agricultural use. Therefore, no disposal problem of this natural waste.

a) Natural dyestuffs create rare color theories which are harmonized immediately.
b) Natural dyes generally are moth-proof and are capable of replacing synthetic dyes for protection in children's clothes and food.[6, 7, 11]

Disadvantages of natural dyes/colorants

Some of the disadvantages of natural dyes are listed below:-

Shades can hardly be reproduced by the use of natural colorants, as these agro products differ between crop seasons, locations and plants, maturation, etc.

When exposed to light, sweat, and air, the treated textile can change colors.

Most of the natural dyes are fugitive. Therefore, their color quickness scores are often not sufficient for modern textile applications.

A lack of accurate scientific information on methods for extraction and dyeing.

A recipe for natural dyes is difficult to standardize because it does not only depend on color development but also materials.[11]

Natural dyeing requires specialized manufacturing and is consequently costly. The low color rates of natural source dyes thus demand more dyestuff, longer dyeing times and more costs for mordants and mordanting.[11, 12]

Classification of natural dyescolorants

Natural dyes can be categorized in different ways Early classified techniques are simply based on alphabetical dyes. Later on, numerous and Many other classification systems were subsequently introduced which are as follows:-

- Classification based on the chemical composition
- Classification based on its origin or source.
- Classification according to their methods of application.
- Classification based on color. **[12]**

Classification based on the chemical composition

Natural organic dyes and pigments are part of various chemical classes, including indigoids, anthraquinonoids, naphthoquinones, polymethines, ketones, imines, quinones, and chlorophyll.[12]

Classification based on its origin or source

Natural dyes are classified into three distinct classes: those from vegetable sources; those from insects and other animal sources and those from mineral sources, depending on their origins or sources from which it is extracted. Vegetable dyes are obtained from different parts of plants and herbs, including stem, wood, roots, bark, leaves, flowers, fruits, and plant skin that produce different shades of pale to dark, on natural and synthetic fibers. Some of the main red dyes were derived from insects or animals depending on the anthraquinone composition. The coloring is characterized by strong lightfastness. They are combined with metal salts to shape complicated metal dyes that have great wash fastness.[12]

Classification according to their method of application

Natural dyes can be classified as either direct dyes or mordant

- Direct dyes for cotton, e.g. turmeric, pomegranate, annatto, safflower, etc.
- • Direct dyes for wool and silk, e.g. turmeric, pomegranate, annatto, safflower, etc.
- • Acid dyes, e.g. saffron.
- Basic dyes, e.g. Berberine.

Both natural textiles can be treated with direct cotton dyes, acid dyes can only be applied to wool and silk, basic dyes can be used for wool and silk and cotton treated with tannic acid. **[27]** On the other side, both animal and vegetable fiber is also appropriate for mordant dyes. Madder, logwood, and cochineal are essential mordant dyes. There is another kind of dyes called vat dyes that are insoluble in water. This includes indigo, woad, and tyrant violet**.[28]**

Classification based on color

Natural dyes are also classified according to the color they provide to the fiber surface. Yellow represents prosperity and happiness and is perhaps nature's most common color There is a significant increase in plants yellow in color compared with the other color, and a total of 28 natural yellow is shown in the Color Index. The Color Index lists 32 natural red dyes some are derived from plant roots or barks and some, such as cochineal, are camouflaged in the bodies of dull grey insects

Dull-grey insects in the skins. The origins of these dyes are therefore limited. Nearly any natural red dye has the basic structure of quinone. The Color Index lists only three natural blue dyes, natural indigo, sulfated indigo, and Japanese Tsuyukusa floral dyes primarily used in paper production.On all fibers, the brightest and quickest blue shades come from indigo. Logwood is a major natural black dye, It is currently also being used to dye silk in deep colors in a mordant iron tannate. It is also very substantive and fast on most natural and synthetic fibers. Most of the natural brown dyes are derived from quinone, naphthoquinone, and anthraquinone. Copper and iron salts are generally used as mordants, and they also turn color, especially brown, to dull and deep shades.**[12, 27, 29]**

Extraction methods of plants components

Aqueous extraction system

This is the simplest and most ancient method for the extraction of natural coloring components worldwide. The raw materials are first dried and finely cut in this procedure, mostly grinded into powder form and then extracted in water by boiling.The content is cooled at room temperature and filtered after boiling at certain times.The filtrate is used as a dye for dyeing. The aqueous extraction of liquid colorants takes place under many variables such as temperature, extraction duration, pH, the concentration of raw materials, and material to liquor ratio.**[29]**

Extraction by acid and alkali assisted system

Color from Euphorbia leaves is extracted for dyeing fabric in a watery medium by adding hydrochloric acid and alkaline pH by adding sodium carbonate. Color extraction from acacia catechu nuts is carried out in an alkaline medium for coloring protein-based fiber. The dye derived from jatropha seed produces a variety of light, even, and soft hues, if extracted under acid/alkali conditions. Under various pH conditions,color elements from jackfruit wood are extracted and optimal conditions for extraction at pH-11.0 have been reported.[27]

Extraction by non-aqueous and other solvent assisted system

The dried materials (leaves, roots, barks, and wood) are grinded to fine particles. The crude dry powder is weighed and solvent extracted using the Steam Heated Extractor Soxhlet Apparatus. For the extraction of various solvents (e.g. acetone, chloroform, ether, n-hexane, alcohol, soda ash, etc.) are employed. The dye extract is evaporated through a water bath on an evaporating platform. The solution is weighed and the percentage output is estimated after evaporation into dryness.**[29]**

Mordant in dyeing using natural dyes

Definition of mordant

The term mordant comes from the Latin word "mordere," which means to bite the surface of a material, which helps fix color on the materials, in which it cannot be alone. **[27]** Few natural dyes are colorfastness with fibers mordant substances used to attach the dye to the fibers. They also increase the efficiency of the dye uptake into the textile and improve color and lightfastness. Certain natural dyes, such as indigo, will be fixed without the aid of the mordant, which is called substantive dye with other dyes, such as madder and weld, have a small fastness and will fade color with washing and light exposure and thus need the use of the mordant in dyeing with them. Mordants have traditionally been found in the wild, wood ash or stale urine that may have been found in acidic fruits or leaves of rhubarb (which contain oxalic acid) for example, Most natural dyes currently use chemical mordants, such as potassium dichromate, ferrous sulfate, zinc sulfate, tannin, and tannic acid, alum, copper sulfate (the toxicity of chrome is a problem, so some practitioners are suggesting it should not be used.**[7, 29]**

Types of mordant

Mordants are prepared in solution, often by adding an assistant to enhance the attachment of the mordant to the yarn or fiber. The most commonly used mordant is alum, generally used in tartar creams as a dyeing assistant, which may yield various colors using an alternate mordant of the same dyefor instance. Iron is used to make colors darker and used as "saddener" Copper sulfate still goes black, but can produce colors that are difficult to obtain.[12]. The brilliance of tannic acid is used traditionally with other mordants. Chrome is great for yellows Oxalic acid is ideal to extract blues from barriers Tartar cream is not only a mordant but also is used to luster wool. [7]

Metallic Salts

Most natural dyes can shape and generate diverse colors of metal complexes. aluminum sulfate (alum), potassium dichromate are several metallic salts used as mordants ferrous sulfate, copper sulfate, stannous chloride, and stannic chloride, etc. The metal mordants are water-soluble and less related to cotton. Pretreatment with oil or tannic acid, therefore, helps to impregnate the fiber with metallic solutions. In a metal salt process, wool hydrolyses the salt into acid and base and absorbs the basic component from the substrate -COOH – group while removing the acid component during washing. The chromic oxide formed is the mordant for chromium salt. Iron salts are commonly used as dyeing and printing mordant,For coloring black on cotton, copper salts are used by tannic acid. [12]

The stannic salts are widely used as cotton mordants, while the stannic salts are not so common and stannic oxide is generated as mordant. Tannin and stannous chloride are processed with Persian berries and produce gold in yellow to orange. As wool, mordant aluminum sulfate is quite effective, but aluminum alone is not. Copper sulfate is used for blue and black logwood dyeing, in combination with aluminum sulfate and ferrous sulfates.Stannous chloride is used as a mordant for wool when using tin salts. Potassium dichromate and alum are typically not selected to mordant silk, but iron salts and stannic chloride are commonly employed as mordants **[27]**

1.1.1. Tannins and Tannic acid

Tannins are natural vegetable mordants that enhance the fiber affinity to dyes by building an efficient connection between the protein of the substrate and other macromolecules.Tannins, therefore, comprise a significant component of the natural yellow, brown, grey, and black dyeing. In most plant tissues, they are present in modest numbers, but abundantly in bark and damaged tissues, including gals and wounds.

Chemically, Tannins are broken up into hydrolyzable tannins, former ones have a gorgeous golden color to the wool and include gallotannins and ellagitannins and condensed tannins (proanthocianidins) (found in oak galls). [12]

Oil Mordants

The oils containing fatty acids like palm, stearic, oleic, ricinos, etc. are naturally found in oil mordants and their glycerides. The main purpose of the oil mordant is to build a complex with metal salt like alum and use it then as a mordant. Alum is water-soluble and does not have an affinity for cotton, so it is easily washed out from the treated substrate There is a greater metal binding capacity in sulfonated oil generated by treatment of concentrated H_2SO_4, due to the interaction with metal salt 'SO3M'.The bonded metal can build a complex compound with the dye, like madder, to make Turkey red colour. [1, 27]

Mordanting Methods

Some dyes can be applied using 3 procedures (before, simultaneous and after) however one approach typically offers better results than the other for most colors.

Premordanting

The textile first gets mordant, then is washed with water and finally dyed with a coloring solution.This is a method of two baths, it takes more time, water, and steam. The most level resultis obtained with this strategy.

Simultaneous mordanting and dyeing

It is a bath method, which is prepared together in the same bath. The material must be dyed and coated with water so that it is easy to store them and dye and mordant may flow thoroughly and reach each portion fast. The textile should be verified correctly and adapted to that; mordant should be dissolved well before being mixed with the material.

Post mordanting

It is consists of basic dyeing and since the lake is not created, perfect dye penetration takes place at this stage. The mordanting fixed the dye through the creation of the lake.**[1]**

Cotton fibre

Cotton is a natural cellulosic fabric. Cotton fibers grow in a ball around the plant seeds, and the staple fibers are soft and fluffy. However, the grade, color, length, and characteristics of the fiber greatly affect the consistency of cotton fiber.

The cotton fibers are mostly produced in the United States, India, China, Egypt. The essential graduation criteria are external appearance, light, and color. Raw cotton is typically colored white or grey.Cotton fibers with good strength characteristics for practical applications are known to be good quality cotton. **[30]**

Physical properties of cotton fiber

The physical characteristics of cotton fibers is followed below:-

- Colour: white, creamy white, white blue, white, and grey.
- Tensile strength: The moderately heavy fiber of 3–5 g/d tensile strength. The wet strength of cotton fibers exceeds the dry strength by 20 percent.
- elongation: does not stress easily and has a 5–10 percent pause elongation.
- • Rigid and inelastic fiber: Elastic regeneration. For an expansion of 2%, it has an elastic recuperation of 74% and an elastic recovery of 45% at 5% extension.
- The density of fiber: 1.54 g/cm^3.
- Regeneration of moisture: 8.5%.
- Heat Effect: Excellent thermal degradation resistance. After several hours of heating, the fiber turns yellow at 120°C, decomposes at 150°C, and is badly degraded at 240°C after a couple of minutes. Cotton burns in the air.
- Sunlight effect: turns yellow in sunlight and begins to lose intensity rapidly due to the influence of UV light and short wavelengths of visible light.
- Age effect: Low force loss when carefully stored. Just a small difference from fresh fibers after 50 years of storage becomes possible.[30]

Chemical properties of cotton fibre

The chemical characteristics of cotton fibers are followed below:-

Alkali effect: Cotton fiber is very resistant to alkali. The fibers are swollen in caustic soda (NaOH), but not damaged. Caustic soda treatment of cotton leads to luster and fiber strength (mercerization process).

Acid Effects: The cold concentrated acids or even the heated diluted acids damage and decay the cotton fiber. In cold conditions, it is not affected by weak acids. 70% concentrated sulfuric acid can dissolve cotton.

Organic solvent effect: Cotton has strong resistance to organic solvents. Cotton can be dissolved from copper complexes such as hydroxides from cuprammonium, diamines of cupriethylene, and similar.

- Microorganism effect: cotton fiber can be attacked by bacteria, fungi, and mildews. Their development is favorable in hot and humid conditions. Weakness of the cotton materials can result Because of microorganism growth. [30]

Dyeing and treatment of cotton fibre using plant dyes

Dyeing of Cotton Fabric using Peanut Pod Natural Dye

These peanut pods can be processed in large sizes and can be commercially and financially prepared. Using a modern technical approach the practice of peanut systems to prepare dye materials and processes has been developed. These natural dyes obtained from Beawar, Rajasthan plants are considered to be of high quality and hence they must be preserved for biodiversity protection. Those peanut pod dyes can be commercially used on a wide scale by the development of processing units and replacing the use of hazardous chemical dyes. This work was intended to concentrate on new techniques of dye extraction and mordant studies to improve environmentally sustainable natural dyeing.The plant is best grown in light, well-drained, and sandy soil. You need a lot of sunlight, hot temperatures, mild precipitation, and a freezing time of 4 to 5 months. [1]

Selection of dye source and extraction method

In the non-sunlight region, the peanut pod had been dried. We grind them into a mixer grinder after they have been dried. Preparing a dye bath with natural dyes requires grinding, soaking, and boiling to extract the dye from the vegetable. The coarser the material, the longer it is necessary to soak and boil.[1]. During grinding, it is made in powder form using the grinder. When the powder shape is ready, it is combined and heated on the gas brick to extract the dye. Fig.1 illustrates peanut pods from the roots and the crushed powder.

Pre-Treatment of Fabrics (Scouring)

Initially, the cotton cloth was scoured. The scouring aim was to reduce the sum of impurities for finishing and reproducible results “caustic soda boil" process was used when textiles were ready to be dyed. Rinsed and squeezed softly, after removing the scouring materials. At room temperature, the scored fabric was dried.

mordanting

The fabric is first mordanted usinga 10% concentration of mordant such as Alum ($Al_2(SO_4)_3$), Copper Sulphate ($CuSO_4$), and Ferrous Sulphate ($FeSO_4$), carefully washed with water and then dyed. It's two baths and it takes more time, more water and more steam. Most levels were obtained with this process.**[31]**

Result Analysis Of Cotton Fabrics With Mordanting Agents

The copper sulfate mordant agent with a colored solution is reacted to the cotton fabric. We found that the best result for cotton is with 10 to 15% at color change in the pre-mordant state rubbing dry with all tests and ferrous sulfate mordanting agent gives the best result and alum mordanting agent gives good to very good results. **[1, 31]**

1.1.2. Antibacterial Finishing of Cotton Fabrics by Dyeing with Olive Tree Leaves

Olive leaves, a by-product of agricultural waste produced from the production of olive fruit, often contain significant amounts of bisphenols and are important in the olive oil industry (10% of the total olive weight). The assessment of these wastes will be useful to the cleaner finishing of cotton fabrics as highlighted. it was investigated about the Antimicrobial activities of the olive leaf extract and the positive role of the olive leaves in microbial infection control. Efficient antimicrobial properties of olive leaf extracts against the Gram-negative or Gram-positive bacteria, as well as the antibacterial properties of the extract of olive leaf transferred to cotton textiles by dyeing are accessible.**[21, 22, 32-39]**

Materials used in this experiment

Pretreated woven cotton (100 percent) fabrics were finished with the olive tree leaves collected from pruned trees The dried leaves were then grinded and depending on the experimental design they were also extracted with water**[32]**. Dried and ground olive tree leaves are shown in Fig. 3.

In conjunction with olive trees and independently six mordant agents were tested. As mordants were used in the analysis, copper

FIG.1. PEANUTS FOUND FROM THE ROOTS AND CRUSHED POWDER OF THE PEANUT POD.

Fig. 2. Peanut pods from the roots and the crushed powder .

Fig. 3. Dried and ground olive tree leaves.

(II), sulfate, tin (II), sulfate iron (II), potassium dichromate, zinc chloride, alum.

Finishing of cotton fabrics

This research aims to analyze and measure the usability of olive trees in textile finishing, An extraction of leaves from the olive tree was prepared. In the first stage of the analysis. The extraction process For ground olive leaves depending on the use of distilled water was carried out. The process took 4 hours. Three extraction cycles have been performed in a plant source tank. The pH of the resulting olive leaf extract is slightly acidic. In the second level. The usability of olive tree leaves in cotton finishing was studied. The extract from herbal wastes, or using herbal wastes directly without extraction, was used for the coloring of cotton fabrics with or without mordant. The cotton was also finished with mordant agents only.**[32]**

Dyeing in a thermal laboratory dyeing machine was done using one of two methods:1) Use the extract as a coloration bath or 2) by applying soil waste to the water to make the coloring bath. The samples were cleaned, rinsed, and dried at room temperature after all the stages of dying. In the washing/rinsing procedures, the pH changes in the dyeing bath produced by olive tree leaves were removed, thus reducing the impact of pH changes on antibacterial properties

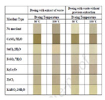
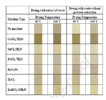
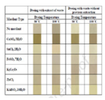
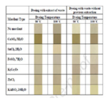
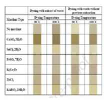
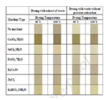
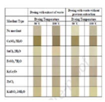
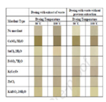
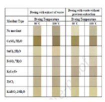
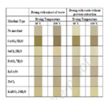
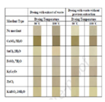
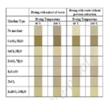
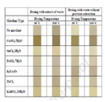
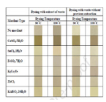
Testing the usability of the waste as a natural dye source

Dyeing at 80°C, using copper II sulfate as a mordant, yielded the greatest detectable color value. even in dyeing at 80°C the lowest value was achieved using mordant tin chloride. In olive leaf extract investigations, K/S values usually rise with an increase in the dyeing temperature except for the dyeing test done with copper II sulfate mordant.

The decrease in the value of K/S occurred as the temperature of the dyeing increased when copper II sulfate was present as a mordant and the dyed samples are viewed in**Table 1**. **[32]**

Good results were obtained in the washing speed testing for color change and staining values. Most studies led to color changes of 4

TABLE 1. change in color of dyed cotton fabric with natural dye with and without mordants.

	Temperature (°C)	
	80	100
Without mordant		
$CuSO_4.5H_2O$		
$SuCl_2.2H_2O$		
$FeSO_4.7H_2O$		
$KAl(SO_4)_2.10H_2O$		
$K_2Cr_2O_7$		
$ZnCl_2$		

or 5, which showed high speed. In dyeing with zinc chloride and alum, however, lesser color change values were obtained. In the dyeing test, the addition of waste or waste extracts did not change the washing fastness much. With various mordant ingredients, a minor difference in washing fastness has been seen., there is no substantial difference in fastness, Due to changes in the dyeing temperature. The results of the light fastness test revealed medium values. Dyeing with tin chloride as a mordant produced the lowest results.

Testing the antibacterial efficiency of olive tree leaves for cotton

The findings of antibacterial efficacy against S. aureus bacteria in the treated samples showed that antibacterial effectiveness may be achieved, depending on the dyeing process. For fabrics treated at 80 °C by extract of olive tree leaves 99.99% bacterial decrease and 99% for dyeing at 100°C. The treated samples were also antibacterial against E. Coli. Dyeing with olive leaf extract at 80°C was a bacterial reduction of 95 percent, whereas dyeing with 100°C was a bacterial decrease of 83%.

Leaf extract application provides a larger bacterial decrease rather than direct dyeing of leaves. The major active ingredient in olive leaves was oleuropein, a secoiridoid natural product, and oleuropein that showed antibacterial action against viruses, bacteria, yeasts, fungus, molds, and other parasites. The antibacterial efficacy of olive trees is therefore probably related to the concentration of oleuropein and other elements such as (Al, Cr, Fe, Cu, Zn).**[32]**

Wool fiber

Wool has a complex surface structure and is one of the most expanded natural polymers. It's made out of the right sheep's skin, predominantly consisting of a diverse morphological structure of pro-steins (97 percent) and lipids (1 percent), **[40]** For wool fibers the scales onto the surface are the main cause of felting shrinkage and contribute to the directional frictional effect**.[41]** It is made of a protein called keratin generated in the process of α-amino acid biosynthesis. Wool fiber is formed from cell death. The wool-forming cells have various structures, forms and shapes, and properties as shown in **Fig. 4.[40]**

Physical properties of wool fibre

Wool is one of the textile fibers widely used alone or in mixtures with other fibers. Because of the presence of this fatty layer. It possesses a hydrophobic external coating that impedes penetration.**[42-44].** Therefore, wool fibers do not have extremely strong water absorption and sweat venting capabilities, which influence the wear of wool material.[45] and we can abbreviate the physical properties of wool fabric in the following :

Length 35 to 250 mm

Color: wool fiber color may be white, white, brown, black.

Flame reaction:- Burnt horn smell.

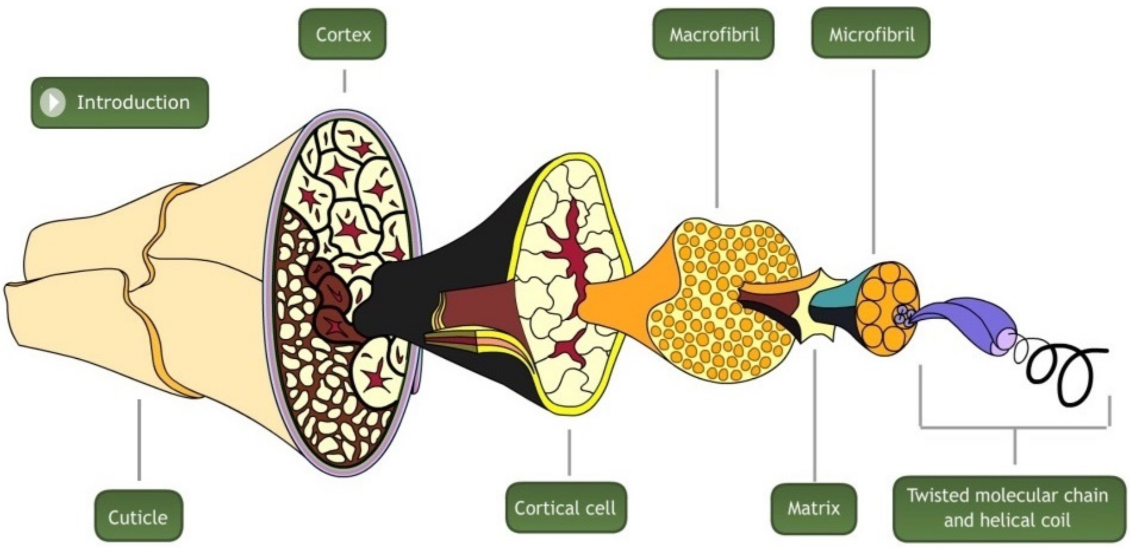


Fig. 4. Wool fiber structure .

Moisture Recovery: 13-16%, extremely absorbent, lower strength when wet, seem warm, shrink in washing.- Luster:- The lustre fiber is larger than fine fiber.

- Electrostatic reaction: Highly electrostatic at dry conditions
- Strength: Dry size =1,35 g/d; weak size of wet = dry 0,69.
- Elasticity: Extension breakage – 42.5 %, Recovery % – 69 at 5%.
- Break elongation: the standard length in wet conditions is 25 – 35% and 25–50%.
- Feeling or Hand: Soft.
- Resilience: Outstanding (due to crimp)
- Abrasion resistance: good.
- Stability in dimensions: bad (For tendency of felting).
- Heat effect: heat has a strong impact on the wool fiber.
- Sun Light Effect: Fibers are stained and provide a harsh sensation.[46]

1.1. Chemical properties of wool fibre

we can abbreviate the chemical properties of wool fabric in the following:

- Acid Effect: wool is attacked and decomposes by hot concentrated sulphuric acid. It is generally resistant to all strong mineral acids, even at high temperatures, however, nitric acids tend to cause oxidation damage.
- Alkaline effects: Wool keratin's chemical composition is very sensitive to alkaline chemicals. Wool will dissolve in caustic soda solutions that have minimal impact. Strong alkaline impacts on wool but low alkaline doesn't affect wool.
- Compression Resistance Effect: Compression resistance values are important to analyze wool's adequacy for various end purposes. Compression resistance (R to C) is the force per unit area required to compress a specific volume of wool. Compression resistance is linked to fiber diameter and to crimp shape and frequency.
- Resilience effect: Wool fibers may be spread up to 50% while wet and 30% when dry, in the original length.
- Effect of organic solvent: in organic solvents Wool does not impact.
- Effects of Insects: Wool affected by insects.
- bleach effect: bleach with chlorine is usually damaging to wool, Bleaching is done with $KMnO_4$, Na_2O_2
- Effect of the microorganism: if it is moist for a long time, mildew is impacted.
- The ability of dyeing: Wool absorbs various dyes without the use of any additional chemicals in-depth, uniformity, and directly. This property makes wool renowned for its gorgeous, rich hues.Colorfastness effect: wool is easy to dye like cotton. This is done with acid dyes, chromium, and mordant **color**s, the **color** molecules are attracted. In the amorphous wool sections.[46]

Dyeing and treatment of wool fibre using plant dyes

Sustainable wool fibres dyeing using henna extract innon-aqueous medium and chitosan as a mordant

Henna is a tree or shrub often grown in India, Pakistan, Iran, Afghanistan, Yemen, Egypt, and Sudan. The powdered plant leaves are used for hair and hand coloring , Henna is often known as hennotannic acid, and give a red-orange color. Henna has various notable benefits, such as not posing a health risk, is readily harm on ised with nature and has a lightly chemical reactivity with no detrimental environmental issues. Pretreatment of wool fibres using chitosan rather than metallic mordants can be a new, environmentally friendly approach to upgrade and reduce pollution to a minimum.

Textiles are treated with chitosan as a multifunctional finish because chemical qualities contribute not only to the antibacterial characteristics but also increase the qualities of dyeing and fastness.[4]

Chitosan pretreatment

1% of chitosan polymer in acidic acetic acid solution has been produced by stirring, Wool fibres were soaked and kept at room temperature in the prepared solution. The samples have been finally padded and cured and then dyed. **[18, 47, 48]**

Dyeing procedure

Treated samples were immersed in a dye bath with henna and decamethylcyclopentasiloxane solution with various concentrations. To spread the tiny particles of decamethylcyclopentasiloxane, two droplets of oleic acid have been added, then Wool fibre was taken from the tin bath and properly washed in tap water and then soaped.[4]

Dyeing and fastness properties

Due to improvement in the coloring absorption and fixation in decamethylcyclopentasiloxane medium, the color strength (K/S) of the sample treated with decamethylcyclopentasiloxane is greater than the water bath treated with the same dye concentration. As the henna extract amount reduced, the color strength of treated and untreated samples reduced and these results are expected as color strength rises as the concentration of color increases. This result indicates the role of decamethylcyclopentasiloxane as a carrier of dyes and does not affect the interaction of henna extract and wool fiber.

All fibres treated are very good to wash fastness compared with untreated fibres. The change in color and staining of nearby textiles (wool and cotton) is good (3–4) to very good (4–5), respectively, while the staining rate of untreated samples was good (3–4) to fair (3) on wool and good to very good. Dry and wet rubbing fastness was found to be excellent with treated samples (4–5), but untreated samples were only fair to good. Regardless of dye concentration and temperature, the light fastness attribute for the treated fibers was satisfactory, but the untreated specimen showed poor fastness.[4]

ffect ofchitosan treatment

Chitosan-treated fibres were stronger in terms of color strength than untreated fibers and this is connected with the presence of primary amino groups with a high color depth in the fiber structuring of chitosan. The rate of dyes absorption and dyes consumption of wool materials was shown to increase when used chitosan with acidic and reactive dyes. The dye absorption and dye fixation of treated samples with chitosan and dyed with henna extract/ decamethylcyclopentailoxane suspension were larger than the untreated samples. This may be explained by the presence of cationic groups in the molecular structure of wool fibers, there by enabling dye particles to spread through the pores of fiber[4]

Cleaner dye extraction and environmentally wool dyeing using oak as eco-friendly mordant

Wool fibers are widely used as natural fibers for preparing textiles. Therefore, it is very important to dye with high color depth. Due to the environmental safety of the area, the use of natural dyes in the dyeing process is highly significant. To get a green, clean dyeing of yarns. Two natural madder and weld dyes originating in Iran were used in dyeing yarns for preparing carpet. Because of the low affinity of natural dyes and the biocompatible nature of the dyeing process, the oak was used as a new tannin-rich mordant.[15]

Extraction method

There are several natural dye extraction processes. It is very vital to select the right way to get the highest benefit with the highest quality. Water or ethanol was used as a non-toxic, recyclable solvent and frequently short-term removal. natural sources were extracted by using Ultrasound-microwave baths containing ultrasound, and Water was chosen as the solvent for extraction. During extraction, a digital thermometer controlled the temperature of the bath and mix, and tiny bits of ice were added if the temperature increases. The combination was finally filtered and concentrated with rotary.[15]

Mordanting procedure

The process of mordanting is vital for dyeing fibers with natural dyes due to their low affinity. In other words, the mordanting increases the colourimetric and fastness qualities of colored fibers. Before mordant, non-ionic soap solution washed the wool yarns to improve surface wettability. The pre-mordant and water solvent techniques were used to the mordant of wool yarn. Wool yarns were produced with 5, 10 and 20 percent of the weight of yarns by oak extraction (as natural mordant), The mordant bath temperature reached 90°C in 30 minutes and then was stirred. Mordanted yarn rinsed with water to eliminate mordants with poor adsorptionand then the wool fabric is dyeing by madder and weld as natural dyes as shown in **Fig. 5**. It was found that the Increasing of the dye concentration increases the tendency of the fibers mordant to the dye molecules such that the K/S value improves.

The effect of using natural mordant

It was observed that, in comparison to the application of metal mordant, pre-mordanting of wool fibres with natural mordant led to the same color , while the natural mordant leads to vibrant colors Thus, in the presence of natural mordant, the color efficiency of wool yarns dyed with eco-friendly dyes is colourimetrical. **{Ragab, on line 2021 #6440}**

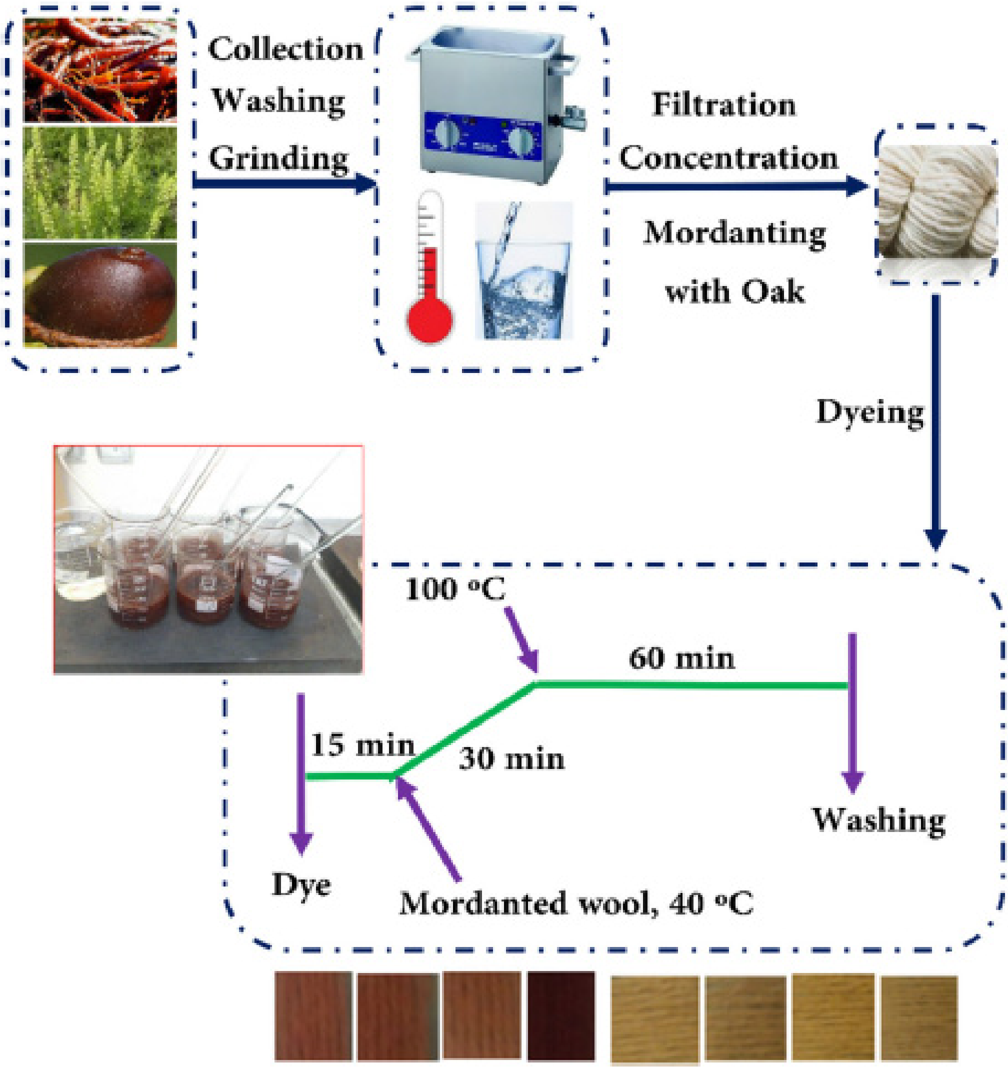


Fig. 5. dyeing process of wool fabric in preens of mordants .

All dyed samples show, very good washing fastness and staining, is around 4–5.The light fastness of the colored yarns was moderate and the colored yarns of the natural and metallic mordant show a greater fastness due to the great strength of the metal complex. The results show that the yarns treated with B. Orellana as a green dye having more washable and light-fastness.**[15]**

Summary

The population increase has resulted in the development and advancement of several sectors, notably the textile sector. The textile industry is one of the polluters of color wastewater generation. Natural materials are one way of reducing pollution. so we resort to several types of plants for being used as dyes, mordants or taking their extraction and used in the treatment of the fabrics such as Dyeing of Cotton Fabric using Peanut Pod and olive tree leaves as Natural Dyes and dyeing of wool fabric with henna extraction, weld and madder and pre-treatment with chitosan as a mordant and using also oak plant as a mordant in dyeing wool.

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الاستخدامات المختلفة لمستخلصات النباتات الطبيعية لتجهيزالخامات النسجية

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لا يسبب استخدام الألوان الطبيعية أي مشاكل في التخلص من النفايات ويمكن أن يوفر أقمشة مصبوغة بشكل طبيعي. قد تكون الأصباغ مشتقة من الموارد الطبيعية منذ العصور القديمة. وأصبح إحياء الأصباغ النباتية المستدامة الآن يومًا ما هو الطلب على المجتمع العالمي في جميع المجالات. لذلك في هذه المراجعة نناقش تطبيق مستخلصات نباتية طبيعية مثل حبة الفول السوداني التي تستخدم في صباغة الأقمشة القطنية واستخدام أوراق شجر الزيتون واستخلاصها لصبغ الأقمشة القطنية وصبغ الصوف باستخراج الحناء مع استخدام الشيتوزان المعالجة بدلاً من ذلك. من الحشو واستخراج مادة طبيعية جديدة من خشب البلوط واستخدامها في صباغة أقمشة الصوف.

الكلمات المفتاحية: نباتات طبيعية؛ صوف؛ أقمشة قطنية صباغة طبيعية لاذع. صديقة للبيئة