Eco-friendly dyeing of Wool fabric using natural dye extracted from onion's outer shell by using water and organic solvents.

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Abstract-*Eco-friendly, nontoxic, sustainable and renewable natural dyes and pigments have been used for coloring the food substance, leather, wood, natural fibers and fabrics from the dawn of human. The purpose of the research is to obtain ecologically colored fabrics for textiles by using a method of dyeing that relies on natural ingredients extracted from onion's outer shell by using water and organic solvents. For the assessment of dyeing quality, dyed samples were conducted with several tests like wash fastness, rubbing fastness, light fastness and K/S value. Comparison also done among water extracted dyed samples and organic solvent (Methanol) extracted dyed samples and all the results came up with good results.*

Key words: natural dyes, onion's outer shell, mordants, mordanting, biodegradable, wool fabric.

Introduction

The natural dyes being neglected for about 150 years, but currently they have again come into limelight. However, the main requirement for their successful revival is to be accepted by and large. On a commercial scale is to develop some new techniques, which are effective enough to provide maximum utilization of available natural dyes. The textile processing industry is well- known for being one of the biggest polluters in the world [1].

Recently, interest in the use of natural dyes has been growing rapidly due to the result of stringent environmental standards imposed by many countries in response to toxic and allergic reactions associated with synthetic dyes. As a result with a distinct lowering in synthetic dyestuff costs, the natural dyes were virtually unused at the beginning of twentieth century [2].

In the west, natural dyeing is now practiced only as a hand craft, synthetic dyes being used in all commercial applications. However with the worldwide concern over the use of eco-friendly and biodegradable materials, the use of natural dyes has once again gained interest [3]. But in many of the world's developing countries like Bangladesh, however natural dyes can offer not only a rich and varied source of dyestuff, but also the possibility of an income through sustainable harvest and sale of these dye plants. Mainly uses large amounts of processed water, chemicals and dyeing products that are harming the environment. There in order to suppress the negative impact of this particular industrial sector, there are two essential ways of protecting nature: building facilities that are efficient and big enough so as to treat the eliminated water and using eco-friendly dyeing products and chemical substances [4].

As natural dyes are used for small scale production, so less capital is required for establishing natural dyeing plant. Most of the people of our country are poor. They can take loan from bank or NGO. So they can easily establish natural dyeing plant. So natural dyeing helps greatly to remove poverty from the society. Dyeing is considered to be an art that goes back to the dawn of humankind. I Europe, dyeing techniques have been developed as early as the Bronze Age. From ancient times, natural dyes have been used for dyeing fabrics and apparel products [5, 6, and 7].

As 76.6% foreign currency is earned from textile and garments sector, so there is an increase in number of textile industries in Bangladesh. So increase in number of dyeing industry. Dyeing industries mostly use synthetic dyes. These synthetic dyes are very much harmful for environment. It pollutes water greatly. So it becomes difficult for micro-organism to live in the water, but natural dyes come from the nature and diminish in the nature. As natural dyes diminishes in the nature, so it does not pollute the environment and do not create any problem for living organism. Natural pigments are considered safe because of their nontoxic, non-allergic and biodegradable nature [8, 9].

All natural dyes are eco- friendly and provide a wide range of beautiful shades with acceptable level of color fastness [11, 12, 13, and 14]. The demand for natural dyes in the modern world is increasing day by day. Such dyes are obtainable mainly from vegetable sources. Global awareness is also set for the use of natural resources for saving the environment and the earth from pollution and ecological imbalances. Today a worldwide trend places a premium on natural food, natural fiber and natural color. The creative potential and non-pollutant nature of natural dyes makes it persuasive possibilities in our lives.

The number of natural dyeing plant is increasing day by day in Bangladesh. At first Kumudini started exporting natural dyed product to the foreign market. They produce such eco-friendly textile product which has high demand in international market. There are also some other industries come into in this sector, such as Aranya Craft, Banglarmela, Aarong, Ahang etc.

Objectives

1. To study the dye ability of Onion's outer shell in Bangladesh.
2. To know about the sources of natural dyes.
3. To know about the extraction of natural dyes and TLC & column test process.
4. To know about protein fiber (Wool) dyeing process with Onion dye.
5. To investigate the effect of the mordant.
6. To know about the color characteristic of the wool fabrics dyed with onion's outer shell dye and including the color fastness to washing and color fastness to rubbing, color fastness to light, and K/S value.

Application of natural dyes on textiles

Natural dyes are mostly employed for dyeing of natural fiber textiles to enhance their eco-friendly characteristics. They are usually applied to textiles by dyeing. Apart from indigo, other natural dyes are usually not used for printing directly. For producing printed fabrics, the printing is usually done with mordant and the whole material is dyed whereby only the area printed with mordant picks up the color. Natural dyes, like synthetic dyes, can also be used to dye textiles at all stages such as fiber, yarn, or fabric. Fiber dyeing has the advantage that any shade variation can be easily adjusted by blending and therefore has been practiced at industrial scale also but is costly due to problems in spinning and loss of dyed fibers. Wool is generally dyed in yarn form and traditional dyers prefer yarn dyeing for all materials as it offers versatility in designing during weaving. Dyeing is normally carried out by hand in large vessels. Iron, stainless steel, copper, and aluminum vessels are used. Dyeing in copper vessels is considered to produce bright shades. Aluminum vessels are normally stained with a particular dye hence should be used if only one type of dye is used. Stainless steel vessels are most preferred for the natural dyeing process. On a larger scale, hank-dyeing machines have been successfully used.

History of Wool

Wool is an animal hair fiber that, chemically, is made of a naturally occurring protein called keratin. This is a general definition that would include the body hairs of many animals but, in common parlance, the word is used for the body hair of sheep. This animal natural fiber comes from sheep fleece. The chemical structure is constituted by the keratin, a complex organic substance formed by amino acids. Its section is round, its structure is scaly.

Physical properties of Wool [15]

Parameters	Value
Specific gravity	1.31
Moisture regain	13 -16 %
Strength>Tenacity>Dry	1.35 g/d
Elasticity>Breaking extension	42.5%
Feel	Soft
Resiliency	Excellent
Abrasion resistance	Good
Dimensional stability	Bad

Chemical structure of Wool

Wool is different to other fibers because of its chemical structure. This chemical structure influences its texture, elasticity, staple and crimp formation. Wool is a protein fiber, composed of more than 20 amino acids. These amino acids form protein polymers. Wool also contains small amounts of fat, calcium and sodium.

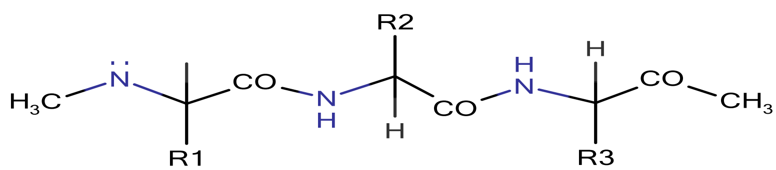


Fig-1: chemical structure of wool

Chemical Composition of Wool Fiber

- Keratin 33%
- Dirt 26%
- Suint 28%
- Fat 12%
- Mineral matter 1%

Types of Wool & Wool Yarn

As regarding the trade classification of wool, the available types are broadly classified as

1. Merino
2. Crossbreds (fine, medium, and coarse)
3. Carpet-wool types

There are two types of wool yarn – woolens and worsteds.

Woolens: Woolens is a general term describing various fabrics woven from woollen yarn that is spun from the shorter wool fibers. These shorter fibers are not combed to lie flat as in the worsted yarn. This results in soft surface textures and finishes and the weave of individual yarns does not show as clearly as in worsted fabrics.
Worsteds: Worsted is a general term for fabrics woven from worsted yarns that contain longer fibers spun from combed wool. Worsted wool refers to tightly woven, smooth, clear finished goods in a variety of twill and other stronger weaves. Wool is an animal hair fiber that, chemically, is made of a naturally occurring protein called keratin. This is a general definition that would include the body hairs of many animals but, in common parlance, the word is used for the body hair of sheep. This animal natural fiber comes from sheep fleece. The chemical structure is constituted by the keratin, a complex organic substance formed by amino acids. Its section is round, its structure is scaly.

Characteristics of Wool

- Flexible fiber
- Good moisture absorbency
- Good dyeing fastness
- Wrinkle resistant
- Non - flammable
- Soft hand
- Sensitive to the sun
- Bad rubbing resistance
- Tendency to pilling
- Tendency to deformation
- Tendency to shrink

Experimental

Materials & instrument

Onion's outer shell, 100% (Wool fabric), Different types of chemicals, Milling machine, Automatic Heater (ZNHW HEATER Co.), Automatic Stirrer, Laboratory dyeing machine, Hot air dryer, Crock meter, Color-fastness tester, ISO grey scale.
Onion's outer shell (Allium cepa) belongs to the Lilliaceae family and is grown all over the world. Yellow onion's outer shell creates a golden range of earthy colors. With a concentrated dye bath and enough time for the fibers to soak, the colors achieved are a combination of red and yellow, usually resting in the middle as an orange. The results radiate warmth and happiness, combining the physical energy and stimulation of red with the cheerfulness of yellow. Protein fibers such as wool and silk dye deep to medium shades of ochre, creating pigments in the cadmium-orange families.
Onion's outer shell are the most commonly discarded household and commercial food waste which can be used as dyes for coloring natural textile materials. These dyes, which are known as pelargonidin (3, 5, 7, 4'-tetrahydroxyanthocyanidin), work like acid dyes that can dye the protein fibers at high efficiency. The amount of pelargonidin was found to be 2.25% in certain solvent extraction process using soxhlet apparatus. Due to presence of four hydroxy groups (Auxochrome groups) pelargonidin exhibits good dyeing properties for dyeing of natural fibers.
The molecular structure of onion's outer shell dye (pelargonidin) is shown in below figure.

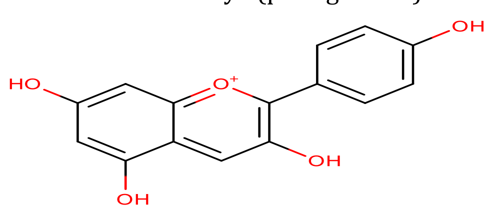


Fig-2: Pelargonidin

Extraction of dyes

As natural dye-bearing materials contain only a small percentage of coloring matter or dye along with a number of other plant and animal constituents such as water-insoluble fibers, carbohydrates, protein, chlorophyll, and tannins, among others, extraction is an essential step not only for preparing purified natural dyes but is also required to be carried out by users of crude dye-bearing materials. As natural coloring materials are not a single chemical entity and the plant matrix also contains a variety of non-dye plant constituents, extraction of natural dyes is a complex process. The nature and solubility characteristics of the coloring materials need to be ascertained before employing an extraction process. The different methods for extraction of coloring materials are:

- ✓ Aqueous extraction
- ✓ Alkali or acid extraction
- ✓ Microwave and ultrasonic assisted extraction
- ✓ Fermentation
- ✓ Enzymatic extraction
- ✓ Solvent extraction
- ✓ Super critical fluid extraction

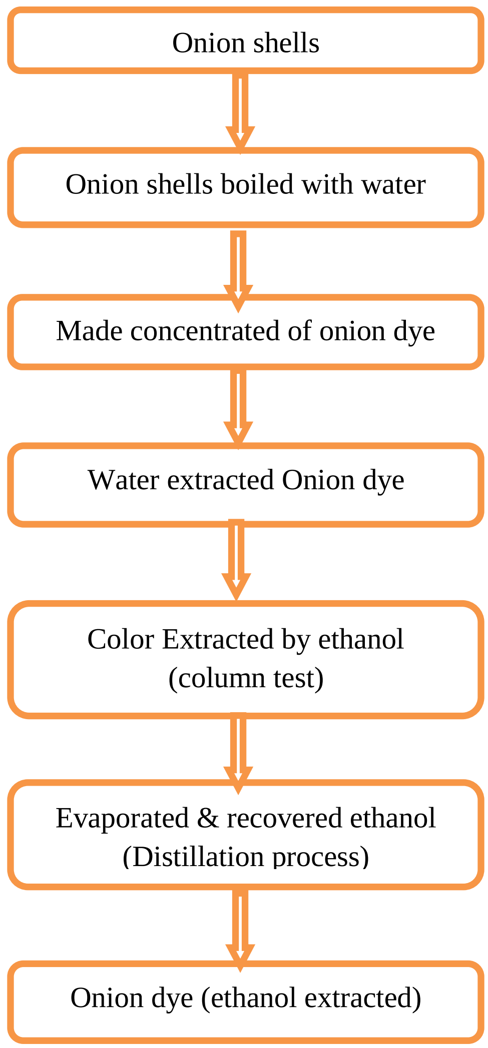
Aqueous Extraction of dyes

Aqueous extraction was traditionally used to extract dyes from plants and other materials. In this method, the dye-containing material is first broken into small pieces or powdered and sieved to improve extraction efficiency. It is then soaked with water in earthen, wooden, or metal vessels (preferably copper or stainless steel) for a long time usually overnight to loosen the cell structure and then boiled to get the dye solution which is filtered to remove non dye plant remnants. The process of boiling and filtering is repeated to remove as much dye as possible. When the extraction is to be carried out on a larger scale for preparation of purified dye powders, stainless steel vessels are used and the time of soaking the materials in water may be reduced by boiling the solution for an extended time period. Generally, centrifuges are used to separate residual matter. Use of trickling filters can ensure removal of fine plant material particles and ensure better solubility of the purified natural dye.
As most of the dyeing operations are carried out in aqueous media, the extract obtained by this method can be easily applied to the textile materials. Disadvantages of this extraction method are long extraction time, large water requirement, use of high temperature, and low dye yield as only water-soluble dye components get extracted whereas many dyes have low water solubility. Also, along with dye, other water-soluble substances such as sugars and the like get extracted that may have to be removed if the extract is to be concentrated and converted to a powder form. Yield of heat-sensitive dye substances gets reduced at boiling temperature; therefore a lower temperature should be used for extraction in such instances.

Solvent Extraction of dyes

Natural coloring matters depending upon their nature can also be extracted by using organic solvents such as acetone, petroleum ether, chloroform, ethanol, methanol, or a mixture of solvents such as mixture of ethanol and methanol, mixture of water with alcohol, and so on. The water/alcohol extraction method is able to extract both water-soluble and water-insoluble substances from the plant resources. The extraction yield is thus higher as compared to the aqueous method as a larger number of chemicals and coloring materials can be extracted. Acid or alkali can also be added to alcoholic solvents to facilitate hydrolysis of glycosides and release of coloring matter. Purification of extracted color is easier as solvents can be easily removed by distillation and reused. Extraction is performed at a lower temperature thus chances of degradation are fewer. The disadvantages of the method are the presence of toxic residual solvents and their greenhouse effect. Another disadvantage of this method is that the extracted material is not readily soluble in water and the subsequent dyeing process has to be carried out in an aqueous medium. Co-extraction of substances such as chlorophylls and waxy materials also creates problem.
The extraction efficiency of colorant components present in natural plant sources depends on the media type, p^H of the media and conditions of extraction, such as temperature, time, material-to-liquor ratio and particle size of the substrate. Onion dye is extracted mainly from onion skin. The onion skins were cut into small units. The wastages are removed and boiled with water or other methods.

Onion dye extraction process by water



Types of Mordant

- **Alum Mordant**

Alum commonly called Aluminum sulphate is the most common mordant. It is classified as the brightening mordant, because it usually produces a pale and bright color. It does not affect the color being produced. Moreover, it can easily obtain from most chemists and is safe as well as cheap to use.

Potash alum, which is the double sulphate of potassium and aluminum, is the most widely used aluminum mordant for natural dyeing. The amount of mordant required depends on the shade to be dyed. If deeper shades are being dyed, more mordant is needed.

Alum is produced as white crystals which are non-combustible and soluble in water. It has been used by human since 2000 BC when the Egyptians used the mineral alum as a mordant in dyeing .Alum or other metallic mordants fix dyes on fiber by chemically combining with the functional groups of the natural dyes to form covalent bonds, hydrogen bonds and other interactional forces as shown in Figure.

Alum occurs in nature but also found in many plants. Alum reacts chemically with water first, whereby the aluminum forms a mildly basic hydroxide which is no longer soluble in water. Alum attaches itself to the mildly acidic groups of the protein molecules of the wool or silk fibers and heat can accelerate the process. During dyeing, the aluminum then binds the molecules of the mildly acidic dyestuff, thereby creating the so-called lac which is insoluble. Hence, the dyes material is colorfast when washed.

- **Copper Mordant**

Copper mordant is copper sulphate, sometimes it is called blue vitriol because it is available as a bright blue crystal. It is a one kind of dull mordants. Copper mordant also reacts with water to form a mildly basic hydroxide .Dyed textiles sometimes having a dull-khaki gold color obtained from a plant will become a yellow-gold color when treated with the alum, chrome and tin mordant respectively. However, the copper mordant produces a dull chestnut color. It is mostly used for fixing the wool colors to produce brown shades . However, Copper mordant is less frequently used than the other mordants. In addition, it is more toxic. The disposal of small amounts of copper mordant and well diluted can reduce the environmental hazard.

- **Chrome Mordant**

Chrome is known as potassium dichromate and is a kind of brightening mordant. It produces a deep version of the prevailing dye color, and leaves wool with beautiful soft, while other mordants will harden the wool.
Chrome is toxic and can cause irritation to skin. Care should be taken to avoid inhaling either the fumes of the mordant bath or the chemical dust. It is better to purchase chrome that looks slightly damp as opposed to a fine, as risk generated from the dust is greatly reduced.

Mordanting

Mordanting can be achieved by pre-mordanting (before dyeing), simultaneously mordanting and dyeing or post mordanting system (after dyeing). For mordanting the fabric at first we weigh the dry materials. Then rinse fabric with cold water. Then we took mordant, water and fabric in a vessel. For this project we used 5% Alum, 5% copper sulphate and 5% potassium dichromate.

1. **Pre-mordanting method**

The textile material is first immersed into the mordant solution for 30 to 60 minutes at the room temperature to 100 °C with a liquor ratio of 1:10 to 1:20. The textile material treated with mordant is then dyed. After dyeing, the dyed material is washed with a non-ionic detergent. It is the most frequently used procedure by natural dyers because large quantities of textile can be treated and stored until dyeing.

2. **Simultaneous mordanting method**

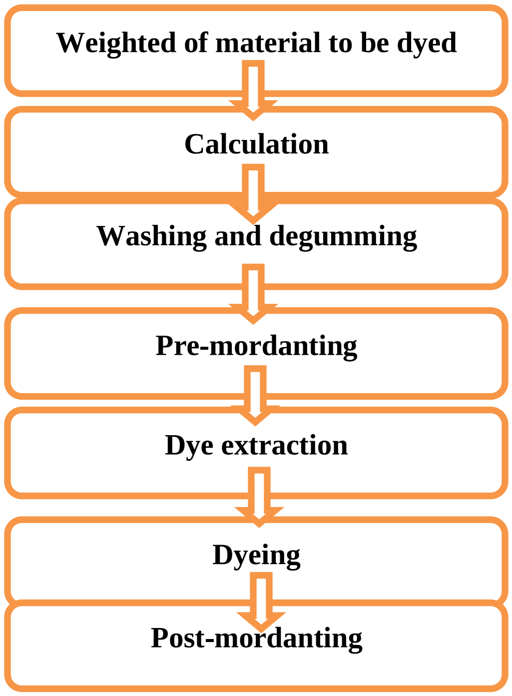
As for the simultaneous mordanting and dyeing, the textile material is immersed in a dye bath solution containing both mordant and dye. Dyeing auxiliaries can be added during the dyeing process. For the optimization of dyeing condition, dyeing process variables can be studied for the specific fiber-mordant-natural dye system in order to improve the color yield of textiles. After dyeing, the textile material is washed with the non-ionic detergent.

3. **Post-mordanting method**

The dyeing process is carried out on the bleached textiles in the dye bath without mordant. The dyed fabric then is treated with another bath called saturator containing the mordanting solution. Treatment condition may vary depending on the type of fiber, dye and mordant system being used. After dyeing, the textile material is washed properly with non-ionic detergent. When using this mordanting method, the colors are usually different and often less strong if the mordant and plant are boiled together. In all these three applications, mordants act as dye setters that will prevent the color from running or streaking after dyeing

Dyeing

It is necessary to follow each stage of the onion dyeing process with care. The stages are:



Evaluation of color strength and color fastness

For evaluation of the K/S value [16, 17, 18] of the undyed and dyed cotton and silk fabrics was determined by measuring surface reflectance of the samples using a computer aided Macbeth 2020 plus reflectance spectrophotometer, using the following Kubelka Munk equation [19, 20] with the help of relevant software:

$$K/S = \frac{(1-R\lambda max)^{2}}{2R\lambda max} = \alpha Cd$$

Where K = The coefficient of absorption; S = The coefficient of scattering; Cd = The concentration of the due and Rλmax = The surface reflectance value of the sample at a particular wavelength, where maximum absorption occurs for a particular dye/ color component.

For evaluation of wool dyed fabrics, the following tests were performed:

- Colorfastness to washing, according to ISO 105-C01
- Colorfastness to rubbing, according to ISO 105-X12
- Colorfastness to light, according to ISO 105-B02
- Colorfastness to water, according to ISO 105-E04
- Colorfastness to Perspiration, according to ISO 105-E04

Result & Discussion

Optimization of extraction condition

Table-1: Surface color strength of dyed of wool fabric with methanol extracted onion dye

Fabric Type	Mordant Concentration :1%	K/S (λ = 400 nm)		
		Pre-Mordanting	Simultaneous Mordanting	Post-Mordanting
Wool	Alum	2.1326	3.0546	2.6896
	Copper sulphate	5.7397	7.4331	9.3124
	Potassium dichromate	2.2553	3.0251	1.8500

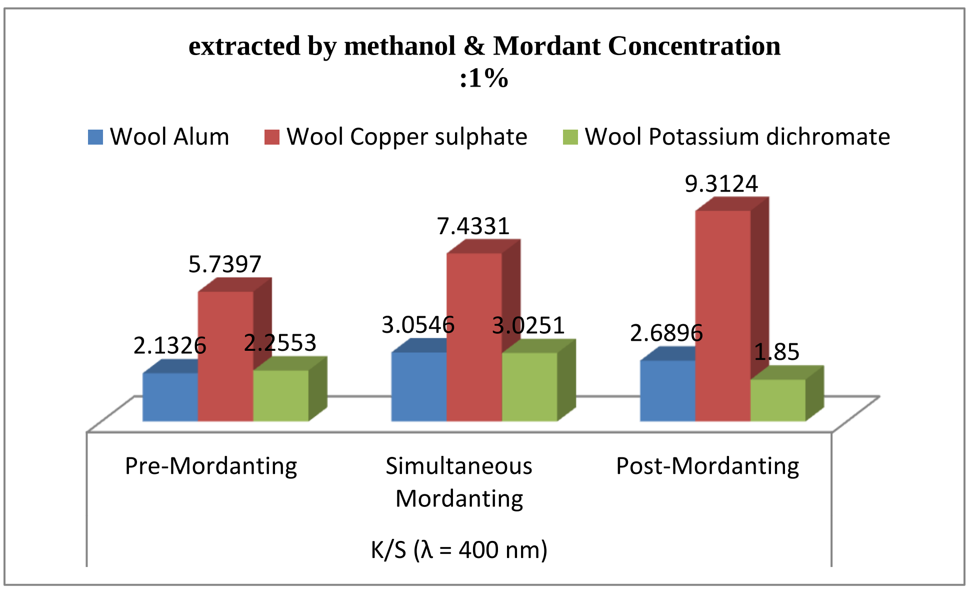


Chart-1: Surface color strength of dyed of wool fabric extracted by methanol

Table-2: Surface color strength of dyed of wool fabric with water extracted onion dye

Fabric Type	Mordant Concentration :1%	K/S (λ = 400 nm) Pre-Mordanting	Simultaneous Mordanting	Post-Mordanting
Wool	Alum	2.0925	3.0518	2.5795
	Copper sulphate	5.3396	7.3412	9.2123
	Potassium dichromate	2.1225	3.0227	1.4501

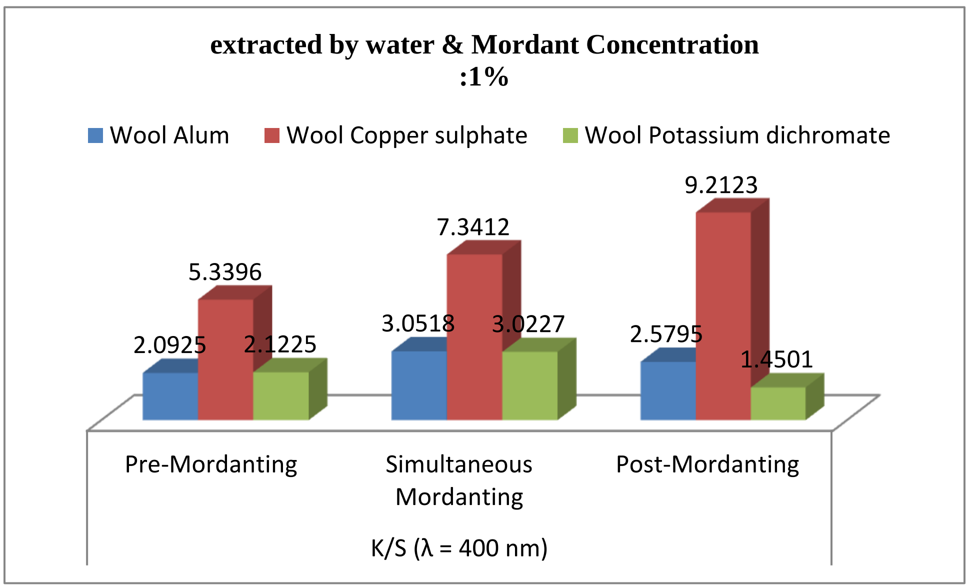


Chart-2: Surface color strength of dyed of Wool fabric extracted by water

Table-3: Surface color strength of dyed of Wool fabric with methanol extracted onion dye

Fabric Type	Mordant Concentration :2%	K/S (λ = 400 nm) Pre-Mordanting	Simultaneous Mordanting	Post-Mordanting
Wool	Alum	2.7847	4.1770	2.8426
	Copper sulphate	6.8934	7.5763	9.9638
	Potassium dichromate	2.4794	3.3979	2.1880

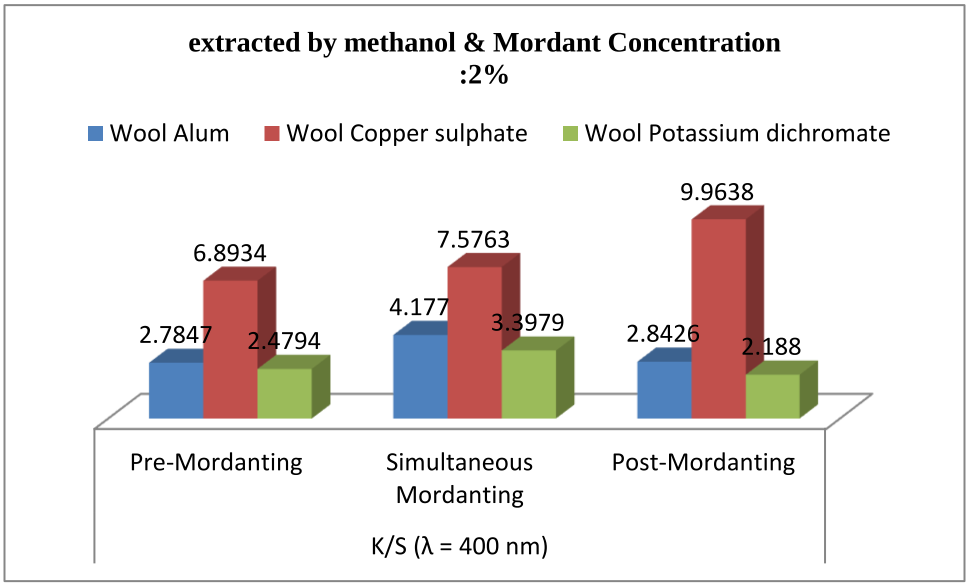


Chart-3: Surface color strength of dyed of Wool fabric extracted by methanol

Table-4: Surface color strength of dyed of Wool fabric with water extracted onion dye

Fabric Type	Mordant Concentration :2%	K/S (λ = 400 nm)		
		Pre-Mordanting	Simultaneous Mordanting	Post-Mordanting
Wool	Alum	2.3846	4.0268	2.4425
	Copper sulphate	6.4933	7.1762	9.5638
	Potassium dichromate	2.0793	3.0878	2.0178

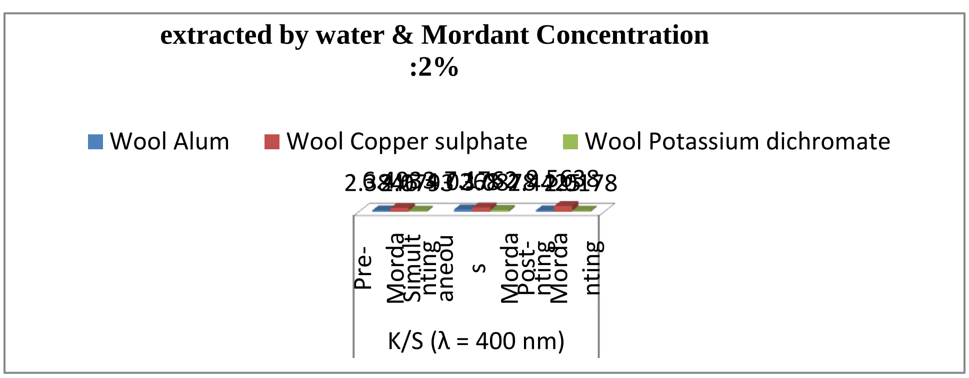


Chart-4: Surface color strength of dyed of Wool fabric extracted by water

Table-5: Surface color strength of dyed of Wool fabric with methanol extracted onion dye

Fabric Type	Mordant Concentration :3%	K/S (λ = 400 nm)		
		Pre-Mordanting	Simultaneous Mordanting	Post-Mordanting
Wool	Alum	2.8398	5.6342	3.1298
	Copper sulphate	5.9613	6.6780	9.6844
	Potassium dichromate	2.2711	4.2563	2.5161

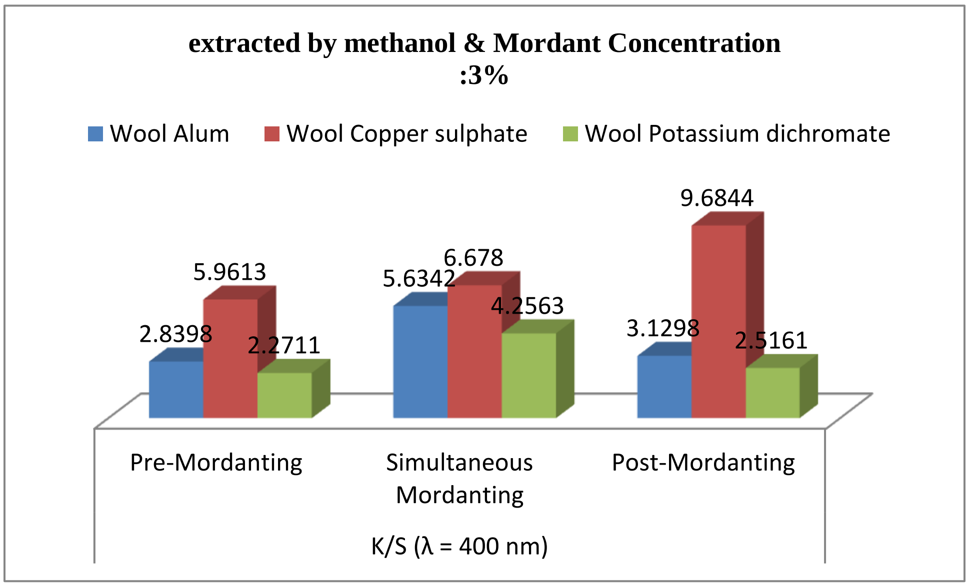


Chart-5: Surface color strength of dyed of wool fabric extracted by methanol

Table-6: Surface color strength of dyed of Wool fabric with water extracted onion dye

Fabric Type	Mordant Concentration :3%	K/S (λ = 400 nm)		
		Pre-Mordanting	Simultaneous Mordanting	Post-Mordanting
Wool	Alum	2.4398	5.2341	3.0287
	Copper sulphate	5.5612	6.4778	9.4844
	Potassium dichromate	2.1200	4.0262	2.1160

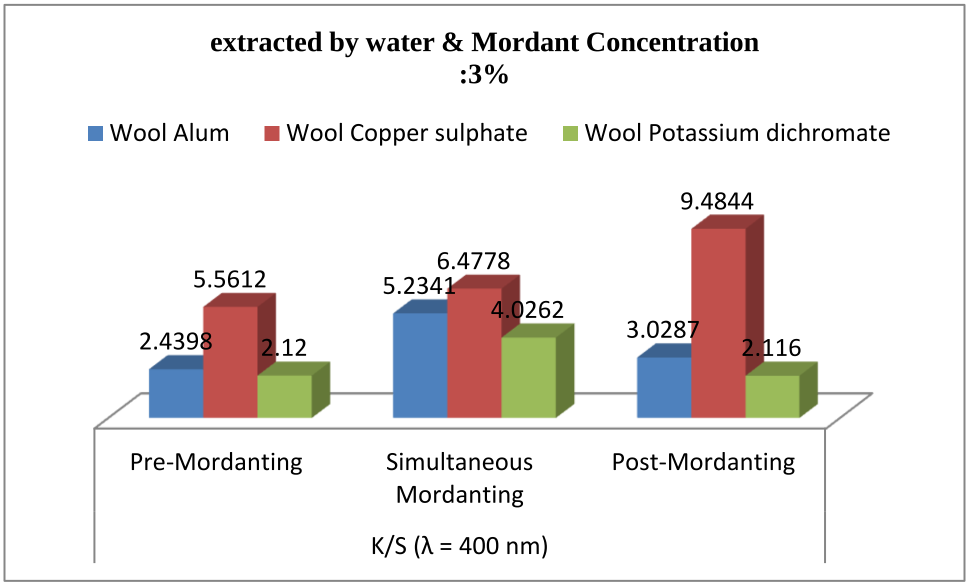


Chart-6: Surface color strength of dyed of Wool fabric extracted by water

Table-7: Color Fastness to Wash of Wool fabric

Fabric Type	Mordants	Method of Mordanting	Mordant Concentration (%)	Washing (Dyed with methanol extracted onion dye)		Washing (Dyed with water extracted onion dye)	
				Color Changing	Color Staining	Color Changing	Color Staining
Wool	Alum	Pre-Mordanting	1	5	4	4	4
		Simultaneous Mordanting	2	5	5	4	4
		Post-Mordanting	3	5	5	5	4
	Copper sulphate	Pre-Mordanting	1	4	4	4	4
		Simultaneous Mordanting	2	5	5	5	4
		Post-Mordanting	3	5	4-5	5	4
	Potassium dichromate	Pre-Mordanting	1	4	4	4	4
		Simultaneous Mordanting	2	5	5	5	4-5
		Post-Mordanting	3	5	5	5	4

Table-8: Color Fastness to Rubbing of Wool fabric

Fabric Type	Mordants	Method of Mordanting	Mordant Concentration (%)	Rubbing fastness (Dyed with ethanol extracted onion dye)				Rubbing fastness (Dyed with water extracted onion dye)			
				Dry Rub		Wet Rub		Dry Rub		Wet Rub	
				CC	CS	CC	CS	CC	CS	CC	CS
Wool	Alum	Pre-Mordanting	1	5	5	5	5	5	4	4	5
		Simultaneous Mordanting	2	5	5	5	5	5	4-5	5	4-5
		Post-Mordanting	3	5	5	5	5	5	5	4	5
	Copper sulphate	Pre-Mordanting	1	5	4-5	5	5	5	4	5	4
		Simultaneous Mordanting	2	5	5	5	5	5	4-5	5	4-5
		Post-Mordanting	3	5	5	5	5	5	5	5	4-5
	Potassium dichromate	Pre-Mordanting	1	5	4	4-5	5	5	4-5	5	4
		Simultaneous Mordanting	2	5	5	5	5	5	5	4	5
		Post-Mordanting	3	5	5	5	5	5	5	5	5

Table-9: Color Fastness to Light and color fastness to water of Wool fabric

Fabric Type	Mordants	Method of Mordanting	Mordant Concentration (%)	Light (Dyed with methanol extracted onion dye)	Light (Dyed with water extracted onion dye)	water (Dyed with methanol extracted onion dye)	Water (Dyed with water extracted onion dye)
				CC	CS	CC	CS
Wool	Alum	Pre-Mordanting	1	3-4	2-3	4-5	2-3
		Simultaneous Mordanting	2	4	3-4	4	3-4
		Post-Mordanting	3	5	3-4	5	4
	Copper sulphate	Pre-Mordanting	1	3-4	2-3	4-5	3-4

	Simultaneous Mordanting	2	4	3	5	4
	Post-Mordanting	3	5	3-4	5	4
Potassium dichromate	Pre-Mordanting	1	3-4	2-3	4-5	4-5
	Simultaneous Mordanting	2	4-5	3	5	4
	Post-Mordanting	3	5	3-4	5	5

Table-10: Color Fastness to Perspiration of Wool fabric

Fabric Type	Mordants	Method of Mordanting	Mordant Concentration (%)	Perspiration fastness (Dyed with ethanol extracted onion dye)		Perspiration fastness (Dyed with water extracted onion dye)	
				Acidic		Alkalin	
				CC	CS	CC	CS
Wool	Alum	Pre-Mordanting	1	4-5	4	4-5	3-4
		Simultaneous Mordanting	2	4-5	4	4	3-4
		Post-Mordanting	3	4-5	4	4-5	3-4
	Copper sulphate	Pre-Mordanting	1	4-5	4	4	3-4
		Simultaneous Mordanting	2	4-5	4	4-5	3-4
		Post-Mordanting	3	4-5	4	4	3-4
	Potassium dichromate	Pre-Mordanting	1	4-5	4	4-5	3-4
		Simultaneous Mordanting	2	4-5	4	4	3-4
		Post-Mordanting	3	4-5	4	4-5	3-4

Dyed samples:

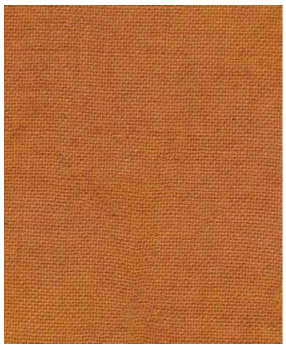
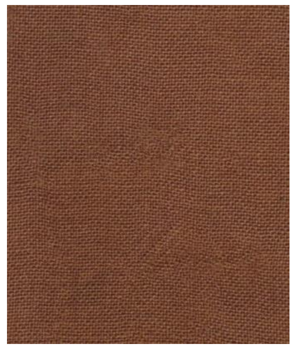
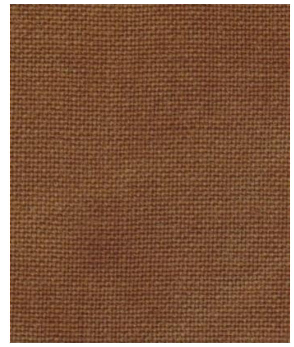
Fabric Type	Mordant type		
	Alum mordanted	Copper sulphate mordanted	Potassium dichromate mordanted
Wool			

Fig-3: Dyed samples (dyed with ethanol extracted onion dye)

Dyed samples:

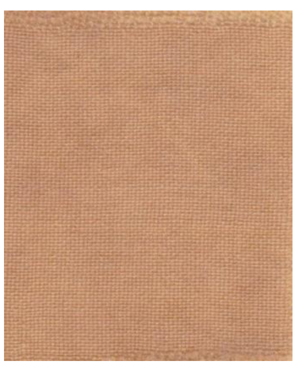
Fabric Type	Mordant type		
	Alum mordanted	Copper sulphate mordanted	Potassium dichromate mordanted
Wool			

Fig-4: Dyed samples (dyed with water extracted onion dye)

Conclusion

In this study, I was tried to explore the difference between two types of solvents used for onion dye extracted from onion's outer shell. The result was very positive for methanol extracted dyed wool fabric than water extracted wool fabric. Dye can be successfully used for dyeing of wool to obtain a wide range of soft, pastel and light colors by using metallic mordants. With regards to colorfastness test samples exhibited excellent fastness to washing (except pre and post mordanting), excellent fastness to rubbing (except pre, simultaneous and post mordanting- Potassium dichromate).Among the different fiber-mordanting systems studied, the use of 3% of Copper sulphate applied by simultaneous mordanting for subsequent dyeing on wool with extract of onion dye 3% of Alum applied by simultaneous mordanting for sub-sequent dyeing on wool with 3% of Potassium dichromate applied by simultaneous mordanting for subsequent dyeing on wool. The graphical presentation K/S value clarified. These studies also reveal that maximum K/S values as compared to other selective pre, simultaneous and post mordanting systems. Over all it can be said that wool fabric dyeing with onion dye by extracts has a good prospect in the field of textiles dyeing sector.

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