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Extraction of Dye From Walnut Shell and Dyeing of Natural Fibre

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Abstract: *A new natural dye was extracted from walnut shell, then applied to wool and cotton fabric. In this research paper development of a process for the extraction of the natural dyes from inedible walnut shell was investigated. Wool and cotton fabric were selected for dyeing. The study shows that the sources can produce different shades of color with and without mordants. Extraction of dye from the walnut shell through acidic and alkaline medium. The result indicates that the extracted dye through Acidic medium show darker shades were produced on wool fabric as compared to cotton fabric.*
Keywords: *dyeing, Extraction of dye, mordants, shade.*

I. Introduction

Nowadays, fortunately there is increasing awareness among people towards natural dyes and dye yielding plants. Due to their non toxic properties, less side effects, more medicinal values, natural dye used in day to day food products and in the pharmaceutical industry [1]. Dyes obtained from natural sources are free from chemicals and they do not have a bad effect on the skin of the wearer. Increased environmental awareness and health hazards associated with the use of synthetic dyes which have led to the revival of natural dyes. Natural dyes are eco- friendly and promote green revolution. They are less toxic and less polluting. It is the need of the day to exploit the forest wealth which can provide us with the significant sources of imparting beautiful dyes [2]. Natural dyes, as proved by many of the studies conducted, have an antibacterial, insecticidal and medicinal properties, due to their natural origin. This application of natural dyes should be considered as a better alternative to synthetic dyes. Use of natural dyes on textile material is now being popularized globally by continuous efforts of the nature lovers. Walnut shell was used in the present study as it is counted as the waste material. So this can be used for dyeing the protein (wool) fabrics. Walnuts are rounded, single seeded stone fruits of the walnut tree. The walnut fruit is enclosed in a green, leathery, fleshy husk. This husk is inedible. After harvest the removal of the husk reveals the wrinkly walnut shell, which is in two halves. This shell is hard and encloses the kernel, which is also made up of two halves separated by a partition. The seed kernels commonly available as shelled walnuts are enclosed in a brown seed coat which contains antioxidants [3].
The two most common species of walnut are grown for their seeds- the Persian or English walnut and the black walnut. The English walnut originated in Persia and the black walnut is native to eastern North America. The black walnut is high flavor, but due to its hard shell and poor hulling characteristics, it is not grown commercially for nut production [4].
The shell of walnut contains a juice that will readily stain anything it comes into contact with. It has been used as a dye for cloth.

II. Experimental

In the present study, 100% cotton fabric and 100% wool fabric were used for dyeing.

2.1 Extraction of Dye

The selected raw material for dyeing the cotton and wool fabric was extracted by weighing 100 gms of the substrate and boiling it in 1600ml of water till the extracted solution was reduced to 300 ml. This stock solution was then filtered and stored.

2.2. Mordanting of cotton and wool fabric

The term 'Mordant' has been derived from the Latin modere meaning 'to bite 'or 'to take hold of '. Mordants are chemicals in the form of metal salts, which are needed to create an affinity between the fibre and pigment, thus allowing certain dyes with no affinity for the fibre to be fixed on it. If the dye is capable of dyeing

the fibre directly, then the mordants help to produce faster shades by forming an insoluble compound of mordant and dyestuff with the fibre itself [5].

2.2.1. Mordant

Alum was used for the study. Pre-Mordanting method was used. Mordanting with aluminum potassium sulphate for 45min at 90^{o}C temperature and M.L.R.: 1:50, was carried out. The mordanted sample was then rinsed, squeezed and dried.

2.3. Extraction of dye

Extraction of dye from walnut in Acidic Medium and Alkaline Medium was carried out.

2.3.1 Acidic Medium

Acidic Medium was prepared by adding few drops of acetic acid in 100ml of distilled water by maintaining the pH 4 to 5. 10g of dye stuff was added in a beaker and it was made to boil at 80^{o}C for 60 min. The solution was filtered and then it was oven dried until the solution turns into powder. Accurate amount of distilled water was added and again pH is checked, if the pH is 4-5 then dyeing is carried out for 1hour at 60^{0}C. Then the samples were allowed to cool at room temperature, and then it was taken out, rinsed in water and dried in shade.

2.3.2 Alkaline Medium

Alkaline medium was prepared by adding sodium carbonate by maintaining the pH 8to 10 in 100ml of distilled water. 10g of dye stuff was added in a beaker and it was made to boil at 80^{o}C for 60 min. The solution was filtered and then it was oven dried until the solution turns into powder. Accurate amount of distilled water was added and again pH is checked, if the pH is 8 to 10 then dyeing is carried out for 1hour at 60^{0}C. Then the samples were allowed to cool at room temperature, then it was taken out, rinsed in water and dried in shade.

2.4 Dyeing of cotton and wool fabric

Dye Materials: 100g, MLR-1:30, Temperature: 60^{o}C and Time: 60 min

Required amount of extracted dye, depending on the shade to be dyed was taken and mixed thoroughly in water according to M.L.R. (1:50). The fabric samples were then immersed in dye stock and the temperature was gradually raised to boil. Dyeing was carried out at this temperature for further one hour. The dyed fabrics were taken out and rinsed first with cold water and then washed with the hot water, soaped thoroughly, washed and finally air-dried in shade at room temperature[6].

2.5 Testing of Dyed fabric

All the dyed samples were tested for their colour fastness properties like – fastness to washing, rubbing and light and colour strength**.**

III. Results

3.1 Colour strength K/S

Colour was evaluated by computer color matching system to analyze the K/S value of the dyed colour sample. Table 1 shows the value of k/s value of a walnut shell dyed sample of wool and cotton.

Table.1: Colour strength of dye wool

Dye	**Fabric**	**Original Dyed Samples (without mordants)**	**With Mordants Aluminium Potassium Sulphate**
		(K/S)	(K/S)
Walnut Shell	Wool	0.83	0.99
	Cotton	0.79	.89

3.2 Color fastness

Evaluation of various properties of dyed samples was done by using grey scale.

3.2.1 Color fastness to light

Light fastness is the degree to which a dye resists fading due to light exposure. Different dyes have different degrees of resistance to fading by light. Fading is caused by the alteration of unstable dye molecules to a less strongly coloured or colourless form. The wool and cotton sample were mordanted with aluminium potassium sulphate and then the samples were dyed with walnut shell dye after which the colorfastness to light was tested by IS 2454. The wool sample mordanted with aluminium potassium sulphate gave an outstanding rating (7) as comparison to cotton (6).

Table. 2: Color Fastness to light on Wool and cotton dyed with Walnut Shell

Dye	**Fabric**	**Original Dyed Samples**	**Dyed Sample & Mordants Alluminium Potassium Sulphate**
		Color Change	Color Change
Walnut Shell	Cotton	6	6
Walnut Shell	Wool	6	7

Overall wool sample dyed with walnut shell gave the best result as compared to cotton dyed fabric.

3.2.2 Color fastness to Washing:

Color fastness to washing was tested by IS 3361. An Evaluation was done using gray scales. The wool and cotton sample were mordanted with aluminum potassium sulphate and then the samples were dyed with walnut shell dye after which the colorfastness to washing was tested by IS 3361 the time used was 30 minutes to 1 hour.

Table. 3: Color Fastness to light on wool and cotton dyed with Walnut Shell

Dye	**Fabric**	**Original Dyed Samples**		**Dyed Sample & Mordants Aluminium Potassium Sulphate**	
		Color Change	Staining on ultilayered Fabric	Staining on multilayered Fabric	Color Change
Walnut Shell	Cotton	6	Only cotton and wool-3	Only cotton and wool-4	6
Walnut Shell	Wool	6	Only cotton and wool-3	Only cotton and wool-4	7

IV. Conclusion

It can be concluded that natural dyes can be used as a substitute for synthetic dyes for dyeing of wool and cotton fabric. The fastness properties obtained are found to be slightly inferior for cotton moderate for wool , however wall ut shell dye gave better fastness properties

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