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A Study of Onion Peel Dyeing on Silk Fabric

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Abstract: **The research was carried out to discover the usage of natural substances which are eccentric and unconventional as similar to the onion peel being the dying material. Dye was taken from the peel of the onion l in medium which is neither basic nor acidic for tinting of silk. The study aims to give out a diversity of colors on the silk cloth by means of oniion (Allium cepa) external skin with various kind of mordants; natural and chemicals like lemon peel, dry gooseberry, pomegranate, alum, ferrous sulphate and sodium hydrosulphate. 3 distinctive methods of mordanting (pre-mordanting, meta-mordanting and post- mordanting) has been used. All the dyed samples were assessed for their color value. Color fastness features have also been measured and analyzed. According to the results obtained, it wasobserved that color fastness to rubbing using lemon peel and alum mordant with pre-mordanting method was better as compared to other samples. Color fastness to washing using lemon peel mordant with pre and meta-mordanting method was better for the color change and ferrous sulphate mordant with the all threemethods like pre, meta and post was good for the colorstain as compared to other samples.**

Color fastness to light was better for silk fabric using Pomegranate mordant with pre and meta-mordanting method and ferrous sulphate mordant with meta and post-mordanting method as compared to other samples. Only lemon peel mordant by the pre and meta-mordanting method is good as compared to othersamples and the k/s value of onion peel dye on silk fabric has proved by making use of the alum and ferrous sulphate mordants with post-mordanting method for best colour shade range, pre and Meta. Chemical mordants are better as compared to natural mordants.

Keywords: Natural dye, dry onion peels, dye extraction,mordant, silk, colour value, colour fastness.

I. INTRODUCTION

Eco-friendly word is in demand in today's scenario. The worldwide main concern is to make the environment free from all types of toxic chemicals which had been become part of day-to-day life and causing huge healthproblems (Miah. M, Telegin. F, Rahman.S. 2016). Thelife cycles of the living being are affected by industrial waste spreading in the soil, air and water. Aquaticanimals and humans are widely affected by industrial waste disposal in rivers and the sea.The hazardous disease spreading all over humanity has made people realize that a clean atmosphere is a need for living. Nowadays natural products are becoming a part of our lifestyle for minimizing pollution. The use of natural dyes in textile colouration is in great demand for their recently discovered properties like deodorizing, anti-microbial, and UV protection. (Gulrajanii, M.L., Guptaa.D, 1992). Natural dyes are bio-degradable, non-toxic, and less allergic than synthetic dyes and havebeen studied globally and a lot of research has been done on them. Natural dyeing of protein fibres has found wide importance nowadays. (Jayamala.M, 2015).The worldwide requirement for natural dyes is increasing day byday because of the broad variety of colours that can be taken from minerals, fungi, and from various parts ofthe plant including roots, barks, leavees, flowrs, skins fruit, and shells of plants. Natural dyes are also famous for their usage in palloring food, leather, and wood, and also natural fibres like wool, silk, cotton, and flax since early era (Rahman. M.d, Alamgir. M.d, 2018).

Natural dyes are famous for their softness, shiny colors and fortitude. Even after a extensive phase, they hold countless attractiveness and attraction. Origiinating from natural sources, they do not make any toxic effluence problems & also provide aesthetic appeal. Synthetic dyes hold better colour fastness and are also cheaper than natural dyes but it involves carcinogenic chemicals which are harmful to the planet and living being (Gulrajani. ML, Gupta.D, 2001). In developing countries, the textile industry is pebbledashing the tremendous influence of the Germanprohibition on 118 definite azo dyes and 20 carciinogenic arylamides as well as benzidine. Apparel sourcing companies, dyerrs, & exportation houses have started looking for the possibility of using natural dyes for dyeing textiles. Large amounts of fruit and vegetable waste are produced on daily basis with a very large amount Glover (B, Pierce. JH, 1993).The bio-diversitynature of earth makes it rich sources of medicinal herbsand plants in different tropical and subtropical regions. Since ancient times, individual humans have been making the use of herbs and plants for therapeutic innumerable illnesses and diseases because of their therapeutic value and easy accessibility in environment. Far ahead with the progressions in technology herbs got major importance in the pharmaceutical commerce because of their suitable chemical arrangement, plentiful obtainability and easy contact. Many herbs show medicinal properties along with the potential of natural colouring pigments for textiles.
Natural dyes are more compatible with the atmosphereas they are not hazardous, non-allergenic, and biodegradable (Sikandri.Z, Ullah.F, Mehmood.S,2020). Looking at environmental concerns, an attempt has been made to explore dye made from Onion peel with mordants on silk fabric.

II. LITERATURE REVIEW

Allium cepa is usually called onion and the bulb includes with plump layers of altered leaves, enclosed by papery external coatings. Skins of Allium cepa, which is the pantry left-over solid, could be taken into use in the natural dyeing of various textile substances (https://en.wikipedia.org/wiki/Onion). In the present study, dry Allium Cepa of onion is

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used for colouring natural textile materials.

Onion is a widely cultivated vegetable from the genus Allium. The onion has green, hollow leaves and the bulb swells when it gains length. Seasonally the leaves fall in autumn and the bulb of onion becomes brittle anddry. (Haq ZU, Gul. B, Shah. SM, 2016)Allium cepa is also used as a vegetable for cooking food in our daily life. Mostly Allium cepa farming contains about 89% water, 4% sugar, 1% protein and 2% fiber. Also, Alliumcepa contains different types of Vitamiins as Vitamin B1, Vitamin B2, Vitamin B3, and Vitamin C. as well aselements like calcium, manganese, iron, magnesium, and zinc (Onal, A, 1996).

The skin of the onion is not edible and is considered wastage. However, it comprises a coloring pigment named "Pelargonidin" (3, 5, 7, 4 tetrahydroxy ant cyanide). The quantity of this coloring pigment is found to be 2.25%, and the structural formula of it is shown in figure 1 (Chandravanshi. S and Santosh. K, Upadhyay, 2013).

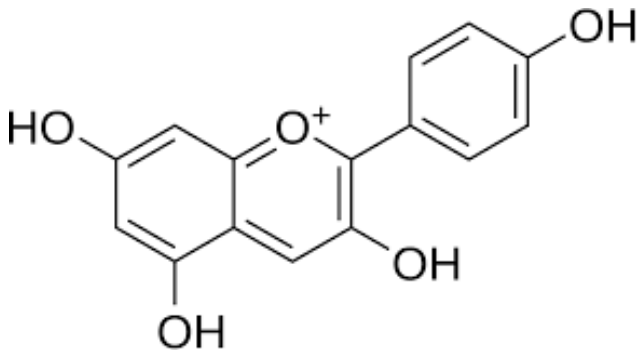

Fig 1: Structural formula of pelargonidin (3, 5,7,4 tetrahydroxyl and cyanide).

Allium cepa can be obtained in a purple and orange hue, while pomegranates and avocado produce brown and purple colours on textiles.

III. MATERIAL & METHOD

The research was carried out on plain weave of undyed tussar silk. The natural & chemical mordants are usedIn the learning to evaluate colour fastness features. Materials used in the study are listed below:

- Fabric: Natural silk fabric (weight-79 g/sm, thread count: 99 x 102, 100% Tussar silk, plainweave)
- Dye: Natural red dry onion peel.
- Chemical: Acetic acid
- Mordants:
- Natural Mordant (Lemon Peel, Dry Gooseberry, Pomegranate)
- Chemical Mordant (Alum, Ferrous Sulphate, Sodium Hydrosulphate)
- Instruments: Wash Fastness tester, LightFastnesstester, Crock meter, and CCM.

IV. RESEARCH METHODOLOGY

In this study, degumming of silk fabric was performed followed by dyeing with red dye extracted from onion peel using different methods like pre, meta & post. The colour values- L* a* b* and various colour stronghold features of dyed fabrics were evaluated

V. EXPERIMENTAL WORK

To study objectives of the research, experimental work proceeded sequentially with material and methods as described below:

- MLR: 1:40
- Onion peel: 15 gpl
- Natural mordant: 10 gpl (Pomegranate powder, Lemon powder, Dry gooseberry powder)
- Chemical mordant:10 gpl (Alum, Ferroussulphate, Sodium hydro sulphate)
- pH: 4-5
- Temperature: 90^{o}C
- Time: 60 min.

i.DEGUMMING OF SILK FABRIC

Degumming of silk fabric were performed in a bath containing 2g/l non-ionic detergent with 1:50 materialsto liquor ratio with the temperature at 90°C for 1 hour. After that rinsed the silk fabric with warm water and dried.

ii.EXTRACTION OF DYE FROM ONION PEEL

Dye extraction was carried out with 15gm of dry onionpeel added to 500 ml of water for 1 hour at 90^{o} C at pH 4. The extraction was stirred continuously at the interval of 10 minutes. The extracted dye was sieved bymuslin fabric and some water was added to maintain theamount of extracted dye solution to 500 ml.

iii.DYEING WITH ONION PEEL EXTRACT

The dye bath is prepared with extracted dye solution atthe MLR 1:40 with a pH of 4. The undyed fabric was dipped into the dye bath by maintaining the temperature at 90^{0} C for 60 minutes with continuous stirafter some interval. After dyeing the sample was detached & wash away with cold water and then dried out.

iv.MORDANTING OF SAMPLE

Mordanting can be attained by three methods. Pre-mordanting is achieved previous to dyeing and meta-mordanting are performed simultaneously similarly, post-mordanting is achieved after dyeing. Forthis research six mordants are considered three arenatural (lemon peel, dry gooseberry, pomegranate) andthe rest are chemicals (alum, ferrous sulfate, sodium hydro sulfate).

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- **PRE-MORDANTING METHOD**

The undyed sample is immersed in mordant solution atthe temperature of 90° C till 30-60 minutes with the MLR 1:40. After mordanting the undyed sample is dyed, rinsed and dried at the ambient condition.

- **META-MORDANTING METHOD**

For the meta mordanting, the dyeing and mordanting process follow at the similar time with the temperature of90°C, MLR 1:40 for 60 minutes. After that rinsing and drying of the dyed sample is performed under ambient conditions.

- **POST-MORDANTING METHOD**

In this process, undyed taster is dyed initially and afterthat mordanting is followed with the MLR 1:40 at a temperature of 90°C for 60 minutes. Rinsing and drying of the dyed sample is done under ambient conditions.

v.COLOUR FASTNESS EVALUATION

- **COLOUR FASTNESS TO LIGHT**

The Light fastness test is performed with MBTL tester. The Dyed Samples were exposed to UV for 50 hours according to the AATCC 16 test Standard ISO105-B02. The blue wool standards were used to check results of light fastness for dyed sample.

- **COLOUR FASTNESS TEST TO WASHING**

The test was performed with the standard ISO 105-CO2. The test specimen compressed both sideswith the undyed cotton fabric. The composite specimen is added to the bath of 5 g/l non-ionic detergents at 50 degrees Celsius for 40 minutes with MLR 1:40. After that rinsing and drying are performed at room temperature. The grayscale is used to assess the colour staining from the dyed sample to two adjacent umdyed samples.

- **COLOUR FASTNESS TEST TO RUBBING**

The test was performed with crock o meter instrument by the test method of AATCC8 Standard ISO 105-X12.For conducting the test two methods are considered dryand wet with 10 cycles of rubbing on a crock o meter. Agrayscale is used to measure the staining of dye by rubbing on the undyed fabric.

vi.COLOUR MEASUREMENT

- **COLOUR STRENGTH K/S.**

The colour strength K/S of dyed fabric is measured by means of a computer colour matching system (CCM) and assessed by using the Kubeka-Munk equation

$K/S = (1-R)/2R – (1-R_0)/2R_0$

K= Absorption coefficient.S= Scattering coefficient.

R_0= Decimal fraction reflectance of the undyed fabric.R= Decimal fraction reflectance of the dyed fabric.

- **COLOUR DATA CIE LAB SPACE**

The colour difference CIE (L*, a*, b*) of dyed and undyed tasters was measured with a data colour spectrophotometer and data colour software interfaced with the computer illuminant d65, observer 10^0, and CIE 1976.

L signifies lightness (L+ lighter, L- darker)
A signifies redder or greener (a+ redder, a- greener)B signifies bluer or yellower (b+ yellower, b- bluer)

VI. RESULT AND DISCUSSION

After performing of degumming of silk fabric, the dyeing process is followed with mordants by 3 mechanisms pre-mordanting, meta-mordanting, & post-mordanting under different conditions to find the various shades of dye. In this research, the onion peel dye as appliedon silk fabric produced better color shades with the alum, and ferrous sulphate mordants by using the post-mordantingmethod as compared to other mordants and methods. The colour shade with diverse mordants and methods are given in table 1.

Table 1: Silk fabric dyed with different mordants usingpre, meta, and post methods.

MORDANT USED	METHOD		
	PRE	META	POST
Lemon Peel			
Dry Gooseberry			
Pomegranate			
Ferrous Sulphate			
Alum			
Sodium Hydrosulphate			

- **COLOUR FASTNESS TO RUBBING**

Colour fastness to rubbing is performed by the crock meter instrument, and the results are determined by thegrey scale

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mentioned in table 2. The rating scale is from1 to 5, where a 5 rating is for excellent fastness and 1 isfor poor fastness. The result obtained from the lemon peel and alum mordant using pre and post-mordanting method was better than meta mordanting (dry and wet both conditions) and as compared to other samples also.The dry gooseberry and pomegranate mordant by pre and meta- mordanting method and ferrous sulphatemordants by using meta-mordanting method were goodin dry condition as compared to other samples. On the other hand for Sodium hydrosulphate mordant by metaand post-mordanting method, colour fastness to rubbing was poor.CC= Colour Change, CS= Colour Stain

Table 2: Color fastness to rubbing.

Mordants	Fabric	Dry /Wet	Pre-mordanting		Meta-mordanting		Post-mordanting	
			CC	CS	CC	CS	CC	CS
Lemon Peel	silk	dry	5	5	4-5	4	5	4-5
		wet	4	4	4	4	4-5	4-5
Dry Gooseberry	silk	dry	4	4	4	3-4	3-4	3
		wet	3-4	3	3-4	3	3	3
Pomegranate	silk	dry	4	4	3	3-4	3	3-4
		wet	4	3	3	4	4	3-4
Ferrous Sulphate	silk	dry	3-4	4	4	4	3-4	3
		wet	3	4	3	3-4	3	3
Alum	silk	dry	4	3-4	4	3-4	4	4
		wet	4	4	4	3	3	4
Sodium Hydrosulphate	silk	dry	3-4	4	3	3-4	3	3-4
		wet	3-4	4	2-3	2	2-3	2

ii. COLOUR FASTNESS TO WASH

Colour fastness to rinse was performed by the mild wash of the sample and assessed with grayscale. Resultin table 3 indicates that, the lemon peel mordant by preand meta–mordanting method give better results followed byferrous sulphate mordant with all three methods like pre, meta and post as compared to other samples. Dry gooseberry mordant by pre and meta-mordanting method have given average rating of 3. All othersamples have shown poor colour fastness to washing. CC= Colour Change, CS= Colour Stain

Table 3: Colour fastness to wash.

MORDANTS	PRE MORDANTING		META MORDANTING		POST MORDANTING	
	CC	CS	CC	CS	CC	CS
Lemon Peel	3-4	2-3	3-4	1-2	2	2
Dry Gooseberry	3	2	3	2	2-3	2
Pomegranate	2-3	2	2	2	1-2	1-2
Ferrous Sulphate	2	3	2	3	2	3
Alum	1	2	1-2	2-3	2	2
Sodium Hydrosulphate	3	2	1	1	1	1

iii. COLOUR FASTNESS TO LIGHT

Colour fastness to light is performed with MBTL light fastness tester for 50 hrs. With blue wool standardresults indicates that pomegranate mordant with pre & meta mordanting and ferrous sulphate with meta & post mordanting methode have produced better colour fastness to light than all other samples. It was followed by sodium hydrosulphate with pre & meta and alumwith post mordanting method.

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Table 4: Color fastness to light.

MORDANTS	PRE MORDANTING	META MORDANTING	POST MORDANTING
Lemon Peel	3	4	2
Dry Gooseberry	4	3	2
Pomegranate	6	6	4
Ferrous Sulphate	4	6	6
Alum	3	3-4	5
Sodium Hydrosulphate	5	5	4

iv. COLOUR MEASUREMENT

Results of colour values in terms of L*, a*, b*, and k/s for silk-dyed fabric with onion peel dye measured witha CCM instrument. The results of colour measurements are mentioned in Table 5. All the onion-dyed sample lies in green-yellow colour coordinates being negative a* and positive b* colour values.

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Table 5: Colour value in term of L* a* b* and K/S value of onionpeel dye on dyed silk fabric with various mordants.

MORD ANTING METH OD	COLOR CO ORDINATES	WITHOUT MORD ANT	Lemon Peel	Dry Goose berry	Pomegranate	Ferrous Sulphate	Alum	Sodium Hydros ulphate
PRE	L*	88.04	91.41	90.86	91.66	89.78	93.08	93.67
	a*	0.207	-0.64	-0.13	-0.11	-0.72	-3.19	-3.43
	b*	-0.94	9.592	8.063	9.968	6.627	15.98	13.29
	K/S	0.924	18.08	15.63	18.79	47.76	62.95	18.03
META	L*	88.04	91.51	91.77	92.34	89.75	93.22	92.43
	a*	0.207	0.040	-0.09	-1.44	-0.57	-2.80	-2.70
	b*	-0.94	9.695	9.067	11.15	6.615	16.39	12.44
	K/S	0.924	18.37	18.23	14.08	39.22	74.95	34.19
POST	L*	88.04	91.20	90.86	91.26	89.46	93.20	93.68
	a*	0.207	-0.14	0.475	-0.10	-0.39	-2.22	-3.93
	b*	-0.94	9.089	8.198	8.973	5.611	16.43	13.56
	K/S	0.924	21.89	20.20	21.24	77.52	83.86	24.35

From the table 5 it is observed that post mordanting methods have provided the best colour shade range, then pre and meta in terms of K/S value. Ferrous sulphate and alum chemical mordants have showed thebest results as compared to natural mordants.

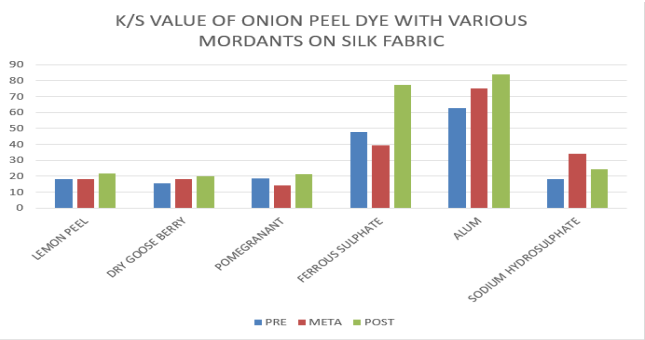

Fig 2: K/S value of onion peel dye with various mordants on silkfabric

VII. CONCLUSION

Textile and Apparel industry has been criticized a lot for deteriorating eco-system. Textile processing industry uses a huge amount of chemicals which may contain heavy metals, formaldehyde and many other carcinogenic compounds. Use of synthetic dye is a major cause of concern with the release of vast amount of effluents causing water pollution as well as serious damage to the eco-system. The use of eco-friendly natural dyes is becoming significantly important due to increase in the environmental awareness. Organic dyes are more well-suited with human and environment as they are non-hazardous, non-allergenic and biodegradable. The examination was commenced to discover the usage of eccentric organic substances like onion peel as dyeing material for silk fabric. Research revealed that a diversity of colors on the silk fabric can be produced by making use of onion (Allium cepa) external casing with distinctive type of mordants; natural and chemicals like lemon peel, dry gooseberry, pomegranate, alum, ferrous sulphate and sodium hydrosulphate using 3 different techniques of mordanting (pre-mordanting, meta-mordanting and post-mordanting).

In this research, the onion peel dyeing on silk fabric produced better color shades with the alum, and ferrous sulphate mordants by using the post-mordanting method as compared to other mordants and methods. The rubbing fastness obtained from the lemon peel and alum mordant using pre and post-mordanting method was better than meta mordanting (dry and wet both conditions) and as compared to other samples also. Colour fastness to washing with lemon peel mordant with pre and meta–mordanting method give better results followed byferrous sulphate mordant with all three methods like pre, meta and post as compared to other samples. Colour fastness to light using pomegranate mordant with pre & meta mordanting and ferrous sulphate with meta & post mordanting methods have produced better results than all other samples.

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