

Application of Eco-Friendly Natural Dyes on Khadi Fabric Garments

Deepa Tyagi

*Assistant professor, Department of Home science, Kunwar Prabha P. G. College, Laldhang,
Haridwar, India*

Abstract

With an increasing awareness of environmental pollution and health hazards associated with synthesis, processing and use of synthetic dyes, there is a worldwide interest in natural dyes for textiles. In the present study, evaluation of acceptability of Khadi fabric garment dyed with dye was evaluated. In this study, eight bark and leaves (Toon, Gular, Bargad, Jamun's bark and Shisham, Mehndi, Guava and Ashok's leaves) were selected to extraction the dye. After extraction the dye, Khadi fabric was dyed with natural dye. Dyed Khadi fabric garment colour properties were tested and then construct the garment (Hanky, Sameej and Scarf) for assessment of acceptability of natural dyed Khadi fabric. 640 respondents were used for the study. Natural dyed Khadi fabrics were sold to the customer to evaluation of acceptability. The questionnaires were used to collect data after using the Khadi dyed fabric. After collected the data we analysis the data and we found that result was good. Hypothesis was tested at 0.05 level of significance using 't' test. We found that all samples were accepted as a good quality of dye. The 't' test were significant at 0.05 level of significance. The dyed Khadi fabric garment was accepted by the customer for their different quality.

Key Words: Natural dye, Khadi fabric, development, colour fastness, visual evaluation, assessment of acceptability

1. INTRODUCTION

Plants and plants source are important for human health and environment. Plants source means any part of plant like wood, root, leaf, bark, flower, fruits. Plants are use for different purpose like paper, medicine, fuel, inks etc but one important use of plants is extraction the natural dye because synthetic dye are allergic and harmful for health and decrease pollution in environment. So now days natural dyes are develop from various plants for their antibacterial and antifungal properties and beneficial for human health and reduced the pollution in environment⁷.

Natural dyes are dyes that are created from bark, on buds, flowers, minerals, rust and other natural materials. Dyes produced in nature that can be animal, plant or mineral based. Natural dyes are excellent for their soft and lusters pastel colours. They give harmonizing colours¹¹.

The use of non-allergic, non-toxic and eco-friendly natural dyes on textiles have become a matter of significant importance due to the increased environmental awareness in order to avoid some hazardous synthetic dyes⁴. Natural dyes are considered to be eco-friendly as these are obtained from

renewable resources as compared to synthetic dyes which are derived from non-renewable petroleum resources¹.

The health hazards associated with synthetic dyes have led to a revival of natural dyes. Naturally dyed materials have good resistance to moth invasion. Some of the advantages are that they are anti-allergic and proven to be safe for body contact. The majority of naturally dyed materials are non-toxic. Natural dyes cover all the dyes which are derived from plants, insects and minerals⁹.

India is famed for its rich biodiversity and there are more than 450 plants which yields different dyes and pigments. Many of these plants are classified as medicinal plants and exhibit excellent antimicrobial activity³.

Khadi production is very harmless to environment, no electricity, chemicals or petroleum products are being used in production⁶.

Textiles can thus enhance cross-contamination by pathogenic microorganisms in environments such as home and hospitals. Textile materials provide an excellent environment for microorganisms to grow, because of their large surface area and ability to retain moisture. Microbial activity can be detrimental to textiles. It can cause unpleasant lead to weakening of the substrate, discolouration, and even contribute to the spread of disease.

In today's world with peoples increasing tendencies toward environmental consciousness and healthy living, organic products raise more and more

interest in the textile sector. In textile dyeing operations, many synthetic dyes and auxiliary chemical are currently in use. Production steps of these synthetic chemicals and discharging chemical to the aquatic media after utilizing in textile dyeing operation can have toxic and discharging chemical to the environmental health so natural dye are safe for human health and environment because waste water of natural dye during process are not harmful for the environment. Its water is used for the different crop irrigation. The demand for greener, cleaner, ethically produced textile continues to grow. Many national and international standard supports to the organic and natural products for environmental safety.

The purpose of this research is to study the antimicrobial activity effect of eight natural dye powder extract solution against selected microbes and then dye the Khadi fabric with antibacterial and antifungal natural dye (AbAfND) and test the colour fastness of fabric and evaluation the acceptability of constructed dyed Khadi fabric.

2. REVIEW OF LITERATURE

The review of literature provided in chapter focuses on objectives all of which touch on development of natural dye based on barks and leaves.

Nwonye, et. al. (2017) defined that Natural dyes can be obtained from various parts of plants such as flowers, roots, leaves, barks, insects' secretion and minerals. These plants can be found in our environment. Although dyes abound in the natural environment, they can also be formed in

different ways and used in different applications depending on their manufacturing processes⁸.

It is known that textile materials and clothing are susceptible to microbial attack because they provide the basic requirements for microbial growth². (Ali, et.al, 2015).

Hossain, et. al. (2018) reported that dyeing with mahogany leaves and green banana pill was found higher k/s value with lemon mordanting and moderate to excellent color fastness to washing and rubbing. Color fastness to light was found good for dyeing with only mahogany and banana pill as well as improved color fastness to light was observed for green banana pill with lemon mordanted sample. Moderate to excellent fastness was found for rubbing, wash and light like color fastness to rubbing, Color fastness to washing, Color fastness to light. This new findings of the present research can be considered for the practice of almost 100% eco-friendly dyeing of cotton fabric without having any negative impact on the environment due to 0% application of synthetic dyes and mordanting. So this research work may be accepted by the scientist as presently environment pollution of textile dyeing and finishing has become the major thinking matter of both scientist concern of textile engineering and environmental engineering. Furthermore chemical structure analysis of all extracted solution of mahogany, green banana pill and lemon can be studied deeply and if it can be matched accurately the related study and research can be purely established in the field of natural dyeing considering more fastness and K/S value which may be invented as eco-friendly dyeing of textile engineering. This research work can fulfill

the versatile colour demand as per customer discussed in literature review⁵.

Sivajiganesan, (2017) studied that the colour fastness properties of the colorant extracted from the bark of Acacia Leucophoea on cotton have studied using different temperate (50⁰C, 60⁰C and 70⁰C) and different hours washing fastness (6h, 7h, 8h) of various chemical mordants. Acacia Leucophloeas barks were found to discharge colours in hot water very easily. The dye extract was found to be suitable for cotton fabric. The cotton fabrics were dyed with chemical mordants. It was observed that the dye uptake was good in 60⁰C washing, light fastness of all dyeing with mordants were quite good and also dye extract has shown good antimicrobial activity. From the comparative study of fastness properties the dyed cotton samples, Acacia Leucophloeas in pre mordanting method gives better results¹⁰.

Tiwari, et. al. (2018) reported that Natural dyes are eco-friendly, biodegradable, non-toxic, and has no side effects on the skin as compared to synthetic dyes. These dyes obtained from different natural sources which may be animal and plants sources (like stem, bark, flowers, leaves and roots of the plants). In the present work, the dye was extracted from the petals of Butea monosperma flowers were used for natural colouring to cotton Khadi fabric with different concentrations of dye i.e. 10%, 20% and 30% using five different types of mordant i.e. P. Granatum, P. Emblika T. Bellirica, A. Catechu and F. sulfate (Iron (II) sulfate heptahydrate) at three different concentration (5%, 10% and 15%). Dyed Khadi fabric was evaluated for colour fastness towards washing, rubbing,

and sunlight. Cotton Khadi fabric samples dyed with *B. monosperma* with 30% concentration of dye and 15 per cent mordants concentration using pre-mordanting method gave good to excellent wash and rub fastness ratings with all mordants. *P. Granatum* and *T. bellirica* mordants with pre-mordanting method using different mordant's concentrations i.e. 5%, 10% and 15% as compare to all other mordants produced moderate fading to no fading against blue dyed standards of 1- 8 rating scale. The dyed samples showed very good colour strength (K/S) and colourimetric appearance using CIE L* a* b* colour space in terms of colour co-ordinates. The fabric samples mordanted with *P. Granatum* gave very good colour strength with all concentrations of dye and mordants as compare to other mordants, respectively. Large ranges of shades were obtained using different types of mordants and their concentrations with petals of *Butea monosperma* dye¹².

3. MATERIALS AND METHODS

3.1:- Collection of source of natural dyes

3.1.1. Source: - Source of natural dyes will be based on Toon, Gular, Bargad, Jamun's barks and Shisham, Mehndi, Guava, Ashok's leaves. The barks and leaves were collected from village Tanshipur, District Haridwar.

3.1.2:-Processing of dye source:- The collected dye source of the barks and leaves were properly cleaned under running tap and then dried in shade then powdered using electronic grinder.

3.2:-Dyeing extraction and optimization

3.2.1:- Selection of the medium of extraction for dyeing:- Aqueous medium was prepared in 300 ml of water without using chemical and maintained the pH 6.

3.2.2:- Concentration of dye stuff for extraction of dyes:- 30 gm dyestuff was used for the extraction of the dye in distill water and the solution was filtered.

3.2.3:- Time of extraction of dyes:- 60 minutes was used for extraction of dyes.

3.2.4:- Temperature for extraction of dyes :- 80°C temperature was used for extraction of dyes.

3.3. Antibacterial screening test of natural dye

3.3.1:- Test solutions of natural dye: - Test solution of a series of concentrations viz. 20, 50, 100, 250, 400 mg/ml were prepared by dissolving natural dye obtained from different leaves and barks in an aqueous medium.

3.3.2:- Bacterial strains: - The natural dye was tested against gram positive bacteria, *Staphylococcus aureus* and gram-negative bacteria, *Escherichia Coli*.

3.3.3:- Preparation of bacterial inoculums: -Stock culture was maintained at 4°C on slopes of nutrient agar active culture for experiments was prepared by transferring bacteria in nutrient broth and that inoculated without agitation for 24 hrs. at 37°C.

3.3.4:-Preparation of media: -The medium was prepared by dissolving Muller Hinton Agar.

3.3.5:- Assessment of antibacterial activity of natural dye: -The antibacterial activity of natural dye was tested against several bacterial isolated using agar well diffusion method.

2.4:- Antifungal screening test of natural dye

3.4.1:-. Fungal strains: - The natural dyes were assessed against standard strains of two fungi namely Chrysosporium fungus and Fusarium Oxysporium fungus.

3.4.2:- Preparation of fungal inoculums: -For the antifungal assay, cultivated slants were used for preparing spore suspension in 0.9% saline water.

3.4.3:- Preparation of media:-The medium was prepared by dissolving PDA media (Himedia) in distilled water.

3.4.4:- Assessment of antifungal activity of natural dye : -Antifungal activity of natural dye from different selected barks and leaves determined, using agar-well diffusion method.

3.5:- Collection of fabric for dyeing

3.5.1:- Fabric:- Khadi fabric were purchased from KHADI BHAWAN, Saharanpur.

3.6:- Preparatory process of the fabric dyeing

3.7:-Preparation of final fabric

3.8:- Optimization of time & temperature for fabric dyeing

3.8.1:- Dyeing time :- To optimize the dyeing time 3 option were considered i.e., 45, 60, 90 minutes than 90 minutes was found best results and this was selected for the study.

3.8.2:- Dyeing temperature :- To optimize the dyeing temperature 3 options were 45, 60, and 80 temperature then 80°C temperature was found best results and this was selected for the study.

3.9:- Identification and naming of obtained colours

3.10:- Measurement of colour strength (K/S Value)

3.11:-Test the properties (fastness) of dyed Khadi fabric

3.11.1:- Light fastness

3.11.2:- Washing fastness

3.11.3:- Rubbing fastness

3.11.4:- Perspiration Fastness

3.11.5:- Water fastness

3.11.6:- Pressing Fastness

3.12:- To construct the naturally dyed Khadi fabric garments and study for customer acceptability

3.12.1:- Garment construction procedure:-

3.12.1.1:-Selection of raw materials:- Khadi fabric was selected to prepare the garments (Hanky, Sameej and Scarf).

3.12.1.2:- Collection of raw materials:- Khadi fabric was purchased from KHADI BHAWAN, Saharanpur.

3.12.1.3:- Equipment used:- For the development of clothing for dye many

type of equipment used. There were sewing machine, picko machine and embroidery machine.

3.12.1.4:- Material used:- Some helping material like scissors, inch tape, thread reel, Milton chalk were used in the preparation of clothing.

3.12.1.5:- Skecthing the garment:- Based on the skin touch fabric feature three garment (Hanky, Sameej, Scarf) sketching was prepared.

3.12.1.6:- Drafting the garment:- Garment drafting was prepared for construction the garment. Drafting was an easy method to construct the garment.

3.12.1.7:- Construct (development) the garment:- Three different type of clothing were developed for dyeing in which Hanky, Sameej and Scarf were prepared with keeping in mind that the garment are use on the direct skin and after dye the garment evaluate the skin allergic properties.

3.12.1.8:- Dye the constructed Khadi fabric:- After construct the garment, All garment were dyed with antibacterial and antifungal dye.

3.12.1.9:- Dye the constructed Khadi fabric:- Dye, picko, embroidery and other construction expenses included in cost of each garment and create the cost label.

3.13:- Sample sell procedure

3.13.1:- Selection of the study area:-

3.13.2:- Locate the study:- This study was conducted in Saharanpur and Haridwar.

3.13.3:- Sampling Method:-

3.13.4:- Sample Design:- Main three garment were used for collected data to the customer. The purposive sampling was used in the study to collect the data from group of Haridwar and Saharanpur city.

3.13.5:- Sample size:- Total 640 samples sizes was taken for this study.

3.13.6:- Tool used for data collection:- Observation cum questionnaire method and opinion schedule was used to collect data and information.

3.14:-Statistical Analysis

3.14.1:-Collection of data:- We collect the data to sold the garments to the customer and take the information related to the customer after and before use the garments.

3.14.2:-Tabulation of data:- Tabulate the data basis of questionnaire information which take the customer during sell the sample to the customer.

3.14.3:-Interpretation of data:- Interpretation the data basis of questionnaire information which take the customer during sell the sample to the customer.

4. RESULTS AND DISCUSSION

The results of various analyses have been presented in separate headings and tables:-

4.1 Evaluation of antibacterial and antifungal activity of natural dye

Table No. 4.1

SR. NO.	NATURAL DYE	ANTIBACTERIAL ACTIVITY		ANTIFUNGAL ACTIVITY	
		Esc. Coli (Zone of inb.)	Stap. Aur. (Zone of inb.)	Chry. Fun. (Zone of inb.)	Fus. Oxy. (Zone of inb.)
1	Toon's bark	4	4	10	7
2	Gular's bark	2	2	8	3
3	Bargad's bark	4	2	2	2
4	Jamun's bark	4	5	2	2
5	Shisham's leaves	2	2	13	2
6	Mehndi's leaves	9	8	8	1
7	Guava's leaves	9	7	1	1
8	Ashok's leaves	2	2	2	1

It is evident from data presented in table 3.1 that Mehndi's and Guava,s leaves extract showed the highest antibacterial activity and Toon,s barks extract showed highest antifungal activity.

4.2.- Colour obtained from dyes

Table No. :- 4.2.

SR. NO.	DYES	OBTAINED COLOUR
1.	Toon's bark	Blusing rose
2.	Gular's bark	Bony peach
3.	Bargad's bark	Flushed Brown
4.	Jamun's bark	Sand Clock
5.	Shisham's leaves	Cashmere-N
6.	Mehndi's leaves	Beige-N
7.	Guava's leaves	Valley Flower
8.	Ashok's leaves	Combre Moon

It is evident from the data presented in table 3.2 that all colour obtained from natural dye were soft and light.

4.3.- Evaluation of colour strength of obtained dyes colours with colorimeter

Table No. 4.3.-

SR.NO.	TEST SAMPLES	WEAVE LENGTH	K/S VALUE
1.	Toon's bark	480	1.18
2.	Gular's bark	420	0.74
3.	Bargad's bark	480	0.63
4.	Jamun's bark	420	1.06
5.	Shisham's leaves	420	1.09
6.	Mehndi's leaves	420	1.69
7.	Guava's leaves	420	1.67
8.	Ashok's leaves	420	0.49
9.	Control (sample)	580	0.02

It is evident from the data presented in table 3.3 that Toon's Gular's bark colour strength was good comparison to other dye and K/S value of Mehndi's leaves was good comparison to other dye.

4.4.- Analysis of fastness properties:-

Table No. 4.4.-

Sr. No.	Natural dye	Light fastness	Washing fastness		Dry Rubbing fastness		Wet Rubbing fastness	
			CC	CS	CC	CS	CC	CS
1	Toon's bark	3	3	5	5	5	5	4
2	Gular's bark	2-3	2	5	5	4	4	4
3	Bargad's	2	2-3	5	4	3	3-4	3

	bark							
4	Jamun's bark	3	4	4-5	4	5	5-4	4
5	Shisham's leaves	3-4	2-3	5	5	5	4	3-4
6	Mehndi's leaves	4	1-2	5	5	5	4	4
7	Guava's leaves	3-4	3	4-5	5	5	5	4
8	Ashok's leaves	3	1-2	5	5	5	4-5	3-4

CC- colour change CS- Colour staining

It is evident from the data presented in table 3.4 that result of fastness properties of Khadi fabric were Satisfactory.

4.5:- Analysis of fastness properties:-

Table No. 4.5:-

Sr. No.	Natural dye	Perspiration fastness (Acidic)		Perspiration fastness (Alkaline)		Water fastness		Pressing Fastness	
		CC	CS	CC	CS	CC	CS	CC	CS
1	Toon's bark	4-5	3-4	5	4-5	4-5	5	5	5
2	Gular's bark	5	4	5	4-5	5	5	5	5
3	Bargad's bark	4-5	4-5	5	5	4-5	5	5	5
4	Jamun's bark	5	3-4	5	3-4	4-5	5	5	5

5	Shisham's leaves	5	5	5	4-5	4-5	5	5	5
6	Mehndi's leaves	4-5	4	5	4-5	4-5	5	5	5
7	Guava's leaves	4-5	5	5	5	4-5	5	5	5
8	Ashok's leaves	5	3-4	5	3-4	4-5	5	5	5

It is evident from the data presented in table 3.5 that result of fastness properties of Khadi fabric were Satisfactory.

4.6:- Statistical analysis of visual evaluation of dyed Khadi fabric with AbAfND

Table No. 4.6 :-

Sr. No.	Natural Dyes	Total marks	Average	Percentage	Mean	S.D.	't'	df	p
1	Toon's bark	3,432	42.09	85.08	686.4	144.19	0.56	4	<0.05
2	Gular's bark	3,525	44.06	88.12	705	146.65	0.74	4	<0.05
3	Bargad's bark	3,563	44.53	89.07	712.6	135.39	0.79	4	<0.05
4	Jamun's bark	3,407.5	42.59	85.18	681.5	133.007	1.43	4	<0.05
5	Shisham's leaves	2,020	25.25	50.05	404	78.45	2.96	4	<0.05
6	Mehndi's leaves	3,457	43.21	86.04	691.4	136.74	0.614	4	<0.05
7	Guava's leaves	3,437	42.96	85.92	687.4	131.26	1.01	4	<0.05
8	Ashok's leaves	1,980	24.75	49.05	396	82.67	2.867	4	<0.05

Further analysis of data from the above table 3.6 reveals that Bargad dyed Khadi fabric was highest visual evaluation taken to the respondents by questionnaires and other natural dyes result was satisfactory.

4.7:- Statistical analysis of assessment of acceptability of dyed Khadi fabric with AbAfND

Table No. 4.7:-

Sr. No.	Natural Dyes	Total marks	Average	Percentage	Mean	S.D.	't'	df	p
1	Toon's bark	3,632	45.04	90.8	726.4	148.56	0.83	4	<0.05
2	Gular's bark	3,672	45.09	91.8	734.4	142.79	0.93	4	<0.05
3	Bargad's bark	3,678	45.97	91.95	735.6	70.61	1.88	4	<0.05
4	Jamun's bark	3,660	45.75	91.5	732	147.60	0.92	4	<0.05
5	Shisham's leaves	3670	45.97	91.75	734	142.012	0.96	4	<0.05
6	Mehndi's leaves	3,664	45.08	91.6	732.8	144.19	0.87	4	<0.05
7	Guava's leaves	3,648	45.06	91.2	729.6	148,04	0.83	4	<0.05
8	Ashok's leaves	3,653	45.66	91.3	730.6	141.93	0.82	4	<0.05

Further analysis of data from the above table 3.7 reveals that Bargad dyed Khadi fabric was highest acceptability taken to the respondents by questionnaires and other natural dyes result was satisfactory.

5. CONCLUSION

It was found that antibacterial and antifungal activity of all AbAfND was good and colourfastness of all AbAfND was satisfactory. Visual evaluation and acceptability of AbAfND dyed Khadi fabric was good. Bargad dyed Khadi fabric (45.97) got highest average value. Respondents aware about the AbAfND and according to respondents AbAfND

was safe for specially children and old age people because in this age they affected soon with the bacteria and fungi. But visual evaluation of Shisham's and Ashok's leaves natural dye was not accepted because their colour and brightness of the Khadi fabric dyed with Shisham's and Ashok's leaves AbAfND was very low. But according to the aspect of acceptability like skin friendly, anti-allergic and wearable Shisham's and Ashok's leaves AbAfND dyed Khadi fabric was accepted because according to customer responses Shisham's and Ashok's leaves AbAfND dyed Khadi fabric wearable and anti allergic.

SAMPLE SHEET-I

Dyed Samples

Bark Dyes

Khadi Fabric

TOON DYE



GULLAR DYE



BARGAD DYE



JAMUN DYE



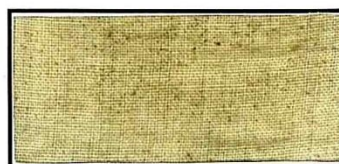
SAMPLE SHEET-II

Dyed Samples

Leaves Dyes

Khadi Fabric

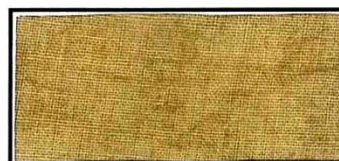
SHISHAM DYE



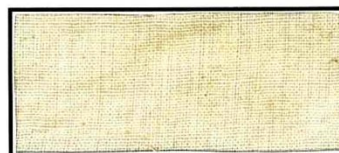
MEHNDI DYE



GUAVA DYE



ASHOK DYE



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