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Block Printing with Dye Concentrate of *Butea Monosperma* Flowers with Gum Extracted from Waste Mango Kernel and Cassia Tora Seeds on Cotton Fabric

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Abstract: ***Natural dyes and natural thickening agents appear to be ideal choice. This is because natural dyes and thickening agents have better biodegradability and higher compatibility with environment. The block printing of cotton fabric using Buteamonosperma flowers dye with gum extracted from Mango kernel and cassiatora seed has been carried out.CIE LAB values have also been evaluated and discussed. Evaluation of color coordinator of printed sample and colour fastness properties were also carried out. Good block prints were obtained. Colour fastness results related to washing, crocking, light and perspiration with alkaline and acidic medium showed good results.***

Keywords: Natural dye, Natural thickening agent, Block printing, CIE Colour values

1. Introduction

Thickeners used in textile printing are high molecular weight compounds giving viscous paste in water. These impart stickiness and plasticity to the printing paste so that it can be applied to fabric surface without spreading and capable of maintaining the design out lines even under high pressure. Natural thickening agents produced from vegetable raw materials. Owing to differences in growing conditions, variations in their composition is unavoidable. For textile printing, the thickeners used must be soluble in water. For this reasons, the water insoluble raw material is either etherified or esterifies to produce water soluble derivative. [1] Bean gum ethers, sodium aliginates, starch ethers, cellulose ethers and crystal gums are natural thickening agents. The main function of thickener is to hold the dye particles in the desired place on the fabric until the transfer of dye into the fabric and its fixation are complete. In the present study gum extracted from cassia tora seed and mango kernel seed is used as thickening agents.

Common use of synthetic fibers and chemicals in textile industry and old technologies will cause rapid pollution to earth and serious ecological problems in future. The best industry is one that pollutes the earth the least. Natural dyes derived from vegetable and other sources are used for different purposes. These natural dyes are ecological not only for human health, but also environment since prehistoric times, natural dyes have been used for many purposes such as colouring the natural fibers, lather and also used to colour the cosmetic products. The chemical structure of a dye molecule is divided into two parts i.e. the main chromophore and auxochromes groups. The analysis of the natural dyes listed in colour Index revealed that almost 50% of all natural dyes used to colour textiles are flavonoids compounds, remaining natural dyes fall within three chemical class viz. anthaquinones, naphtoquinones and indigoids. [2]In this study Flowers of *Buteamonosperma* are chosen as plant based natural dyes**.** Flowers of *Buteamonosperma*are found abundantly on the outskirts of forests and scattered wastelands .*Khara,Palash,Khario, Tasu and Kesula* are the local name of Flowers of *Buteamonosperma*. It has butin, chalcone, orange-yellow needles and small quantities of butin, the colourless isomeric flavanone and its glucoside, butrin. [3]

Natural dyes and printing can exhibit better biodegradability and generally have a higher compatibility with environment. In the recent years concern for environment has created an increasing interest in eco-friendly, biodegradable and non toxic rational products. Cotton belongs to natural cellulosic having good affinity towards colour fastness properties. Mordant are used for dyeing purpose. Mordants are considered as integral part of natural dyes and govern the colour obtained so that the same dye produces different colour with different mordants. There are various type of mordant used for dyeing with natural dye but in present study copper sulphate and ferrous sulphate are used as mordant. The objective of present study is to carry out block printing with the natural thickening agents and natural dye on cotton fabric and evaluate the colour fastness properties.

2. Material and Method

Fabric: plain white grey fabric was purchased from market. Scouring was done in order to remove the impurities from the fabric. Fabric was boiled for 45 min. in a solution containing 2grams of nonionic detergent and one gram of NaoH per liter of water. After this by kneading and squeezing the samples were rinsed in tap water and sun dried.

Pretreatment of fabric: The fabric was pretreated with 20 percent of *myrobalan* solution for 24 hours maintaining the

1:20 MLR(material to liquor ratio) the fabric was squeezed in both warp and weft direction and sun dried. The side exposed to sunlight was darker and was used for printing.

Dyes: Flowers of *Buteamonosperma*were collected from nearby forest and dried in shade and pulverized to powder form. Aqueous method was used for dye extraction.

Mordants used: Metal salts were used to provide exhaustion and fixation for printing paste to textile materials. Metal ions are collected on fiber surface in an aqueous media and supported printing textile materials creating natural dye and metal ion. In the present study Copper Sulphate (0.5%) &Ferrous Sulphate (3%) are used as mordants.

Thickeners Used: Mango kernel gum (1.5%) and Cassia Tora seed gum (2.5%).

Preparation of printing paste: Seed gum of selected concentration was dissolved in10ml of luke warm water.The mixture was kept undisturbed for 15 minutes. The required mordant was mixed in 5ml. of luke warm water. 10 ml of gum and 5ml of mordant was added to the dye concentrate with constant stirring. The mixture was mixed for 5-10 min. The remaining water was added and boiled the mixture till the required thickness is obtained.

Printing technique: All the printing paste was applied to the fabric through block printing technique. Printed samples were after treated with Alum (A_{12} So_4). Fixation ofthe printed goods was done by steaming at125^{o}for30 min.

Measurement of fastness properties Colour fastness test to light, washing, crocking or rubbing was carried out in Fad-o-meter, launder-o-meter and crock-0-meter respectively and fastness was rated as per rating given in Grey scale [4]

CIE (International Commission of Illumination) Lab value CIE lab values are the colour difference values between the sample and the standard which are read from the colour difference scale.

Evaluation of colour strength- Colour strength (K/S value) of a printed sample was measured at wavelength of maximum absorption of each of the colour on MS 2000 (colour eye 3100), Macbeth UV spectrophotometer. These values are computer calculated from reflectance data according to Kubelka-munk equation.

Evaluation of colour value- Colour value of the sample was analysed on the basis of L*a*b* values using reflectance spectra through (colour eye 3100) Macbeth UV spectrophotometer. The L*value is a measure of lightness and darkness of the colour while to define the colour on a two dimensional chromatic space of green-red axis and blue-yellow axis, a* and b* values were evaluated.

CIE lab Coordinator: The CIE coordinator L, a* and b* of the sample printed were evaluated. The higher values of a*and b* indicate brightness, which is more due to redness and yellowness, respectively and negative value indicate greenness and blueness, which are more dullershades. The lower value of L* indicates the greater the depth of colour.

3. Results and Discussion

In order to compare the effect of two thickening agent .Cotton fabric was printed with natural dye extracted from flowers of *Buteamonosperma*with two different mordant. The K/S values and their corresponding fastness properties were evaluated on different parameters.

Evaluation of color coordinates of block printed sample: The color values of the printed fabric using different mordants and thickening agents are summarized in table-1When the printing was carried out without any mordant, theprinted tone of the printed material obtained were light in shade and color bled heavily after washing however the *myrobalan* pretreated samples were printed it gave deeper and faster print .In case of $CuSo_4$/$FeSo_4$ thecolor value were higher.The varying combination of mordant resulted in different shades and tones. This is evident from CIE color co- coordinator result shown in table. The printing obtained using *Buteamonosperma*flowers dye in case of FeSo4 were more golden yellow (distinctly lower a* value for higher b* value) in as compared to the respective printing, obtained using CuSo4. In case of Mango kernel seed gum no district in tonal variationwas observed, although K/S values were slightly but distinctively higher for FeSo4 then that of CuSo4.In case of Cassia seed gum nearly similar K/S values are observed.Higher L* values relates to increase in brightness, since L*values were closer to 100 brightness of the shades was very good. The a* values are negative which shows greenish shades b* values were positive indicating yellowish shade.

Table 1: Effect of thickening on colour strength of Block printed cotton fabric

CIE Colour Coordinates/Mordants	*Mango kernel gum*		*Cassia seed gum*	
	$FeSo_4$	*$CuSo_4$*	*$FeSo_4$*	*$CuSo_4$*
K/S	17.45	14.54	23.83	23.38
L*	77.27	71.39	63.07	76.08
a*	-0.48	-1.28	-1.91	-0.28
b*	28.55	19.58	17.97	29.18

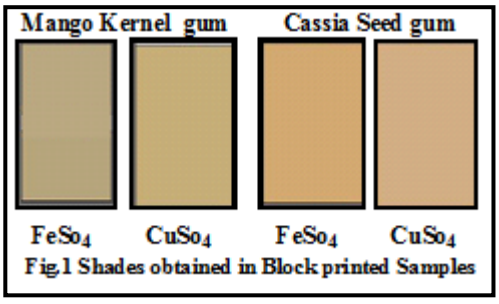

Fig.1 Shades obtained in Block printed Samples

Evaluation of colour fastness properties of printed sample

The result in table indicates the comparative fastness properties in case of both mordant and thickening agent. The printed samples without mordanting showed much inferior fastness properties to those obtained with mordanting (irrespective of the type) which indicate the positive role of mordant holding the dye on the fabric .It is well known that

the use of mordant is essential to fix most of the natural dye on the textile fabric.

The Light Fastness: The light fastness was measured by the fading of dyed or printed colors in light. It is suggested that fading may be due to some kind of breakdown in the light energy absorption capacity of the electrons of the chromospheres or a breakdown in the structure of the dye molecule. When sunlight energy is absorbed, the loosely held electrons of the chromospheres are raised to a higher energy level; that is, they become more active. It is known that ultraviolet component of sunlight will in time initiate chemical reaction. Such chemical reaction will be accelerated under moist conditions. Fading in sunlight is due to partly to ultraviolet radiation that initiates chemical degradation of loosely held electrons of chromophores. Fading of dyed or printed textile material does not occur so readily in artificial light, mainly incandescent and fluorescent light, as these light sources don't emit significant quantities of ultraviolet radiation. Data in table clearly reveals that there was decease in K/S values of the samples but increase in L* values and slight variation can be judged by CIE colour coordinates. Light fastness grades rating were 7 which indicate excellent resistance towards light.

Table 2: CIE Colour Coordinates and Light fastness Grades of BlockPrinted fabric

CIE Colour Coordinates	c/E	Mango kernel gum		Cassia seed gum	
		$FeSo_4$	$CuSo_4$	$FeSo_4$	$CuSo_4$
K/S	C	32.65	16.92	12.20	19.40
	E	25.14	17.37	13.41	17.76
L*	C	61.88	71.27	73.39	67.64
	E	69.94	67.02	77.64	68.08
a*	C	-0.29	-0.40	-0.87	-1.30
	E	0.672	-1.57	-0.71	-2.14
b*	C	21.29	23.00	21.04	19.1
	E	26.08	19.48	25.31	18.65
Fastness Grades	C	7	7	7	7
	E	6	7	6	7

(Sun light fastness Rating 1-poor,2-fair,3-moderate,4-good,5-better,6-very good,7- best &8-excellent)

Table 3: CIE Colour Coordinates and Rubbing Fastness Grades of Block Printed Cotton Fabric

CIE Colour Coordinates	Rubbing		Mango kernel gum		Cassia seed gum	
			$FeSo_4$	$CuSo_4$	$FeSo_4$	$CuSo_4$
K/S	Dry		18.35	22.45	14.08	16.13
	Wet		16.35	14.50	20.56	20.56
L*	Dry		61.80	75.54	69.15	73.19
	Wet		58.03	71.73	72.66	75.00
a*	Dry		-1.32	-0.28	-1.3	.022
	Wet		0.30	.354	-.799	-.328
b*	Dry		17.98	26.33	18.12	28.82
	Wet		13.73	28.59	21.49	26.88
Rubbing Fastness Grades	Cc	Dry	4	4	5	5
		wet	4	4	4	4/5
	CS	Dry	4	4	5	4
		wet	4	4	4	4

Crocking Fastness: Crocking is the transfer of color from a colored textile to another fabric surface through the rubbing process. The extent of rubbing may be influence by the moisture, as many textiles transfers more color when wet. The test requires a crock meter & color transfer is then evaluated using the standard chromatic transference. Rubbing fastness grades in table is 5 and 4/5 for colour change. The colour fastness grades for colour staining ranged between 4-5. CIE colour coordinate results also support the rubbing fastness grading gray scale for staining. The rubbing fastness is assessed by two parameters which are dry and wet.

Washing fastness: Colour fastness to washing of the block printed samples was evaluated. A solution containing 5g/l soap solution was used as washing liquor. The sample was treated for 60 min at 50^o C using liquor to material ratio 50:1 in launderometer. After rinsing and drying the change in the colour of samples were evaluated on the respective scale. The washing fastness grades in the table shows very good to excellent wash fastness to non ionicsoap. CIEcolour coordinate data also support the wash fastness grades.

Table 4: CIE Colour Coordinates and Washing Fastness Grades of Block Printed Cotton Fabric

CIE Colour Coordinates/ Mordants			Mango kernel gum		Cassia seed gum	
			$FeSo_4$	$CuSo_4$	$FeSo_4$	$CuSo_4$
K/S			12.17	22.66	14.07	21.46
L*			61.68	73.84	49.62	76.85
a*			-2.14	-1.6	-1.80	0.44
b*			16.06	29.41	10.09	29.88
Grades	CC		5	5	4	5
	CS	W	4	4	4	5
		C	4	4	4	4

(CC=Colour Change, CS-Colour staining W=wool,C=cotton,,(Rating1-poor,2-fair,3-good,4-very good & 5-excellent)

Table 5: CIE Colour Coordinates and Perspirometer Grades of Printed Fabric

CIE Colour Coordinates/ Mordants			Mango kernel gum		Cassia seed gum	
			$FeSo_4$	**$CuSo_4$**	**$FeSo_4$**	**CuSo**
Acidic Medium						
K/S			14.08	12.20	21.5	34.3
L*			69.15	73.39	58.54	63.27
a*			-1.3	-.87	2.53	3.50
b*			18.12	21.04	19.40	28.5
Grades	CC		5	5	4/5	4/5
	CS	W	4	4/5	4	5
		C	4	4	5	4
Alkaline Medium						
K/S			34.25	8.86	19.74	20.42
L*			47.48	68.33	68.35	64.91
a*			4.14	1.96	-1.47	-2.4
b*			12.94	16.25	21.09	18.70
Grades	CC		4	5	4/5	5
	CS	W	4	5	4	4
		C	4	4	5	4

(CC=Colour Change, CS-Colour staining W=wool ,C=cotton,,(Rating1-poor,2-fair,3-good,4-very good & 5-excellent)

Perspiration fastness : Almost all block printed cotton sample showed good performance during acidic and alkaline perspiration test as L* values shows slight variation during acidic and alkaline perspiration test, except ferrous sulphate treated mango kernel thickened block printed sample where L* value decreased. This result is also supported by

Perspirometer grades where the colour becomes slightly darker. No colour staining was observed. Colour of block printed fabric becomes slightly darker in case of alkaline medium with mango kernel gum; while shade becomes darker with cassia seed gum in acidic medium as revealed by CIE colour coordinates.

4. Conclusion

The entire study reveals that cotton fabric can successfully block printed with gum extracted from cassia and mango kernel with Flowers of *Buteamonosperma* dye extract. Printed fabric exhibited good to excellent colour fastness properties towards sunlight, dry and wet rubbing, washing and acidic and alkaline perspiration. It can be concluded that Cassia and mango kernel thickened printing paste can be safely used for block printing.

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