A STUDY OF BLOCK PRINTING ON COTTON FABRIC WITH PIGMENT OF PARIJATAKA

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Abstract

Block printing is a technique of decorating fabrics or textiles by using dye powder, thickener, and some auxiliary to make the dye fast, where all this process is done by hand. For this study, the cotton fabric of the plain weave was selected. The natural dye source was taken as an orange colour stalk of the parijataka flower, and its pigment was extracted in the aqueous medium. Guar gum thickener was selected for the preparation of printing paste. A wooden block of a square shape was selected. The printed fabric was allowed to dry for different time scales. Dried samples were treated with a solution of metallic salts (mordants) such as FeSO4, Alum, AlSO4, CuSO4 for the fixation of pigment of parijataka flowers. Colour fastness properties of block printed fabric were tested. It was found that 6-8 hours of drying of block printed samples effectively transferred pigment from the layer of guar gum thickener and developed a bright orange color on the fabric. Selected metallic salts were adequate for the dye fixation and development of various shades of dark orange, dry leaf brown, brown, and light peseta green. Colour fastness properties were found to be very good to good.

Keywords: block print, colour fastness, cotton, dye fixation, mordants, thickener.

Introduction

Block printing is a hand skill, a low-cost fabric printing process of surface decoration, beautifying, and attracting consumers. It also increases the cost of fabric. Printing is applying the colour paste on the surface of the fabric in the selected area with machinery or by hand with any device. Wooden blocks of carved design of floral and geometrical of any size are now available in the market. It can also be prepared for the requirement of printing articles such as pillow covers, table cloth bed sheets, sari, and Punjabi dress material. Even after multiple uses of wooden blocks are not spoiled, the carved design remains the same, and care of the block is elementary, but each separate color block is required. Guar is a legume. It is also called a cluster bean with the botanical name Cyamopsis tetragonoloba. It is used as a vegetable in daily food items in the form of curry. It has been reported that guar possesses properties useful in warp sizing and textile finishing operations. The prime function of the thickening agent in textile printing is to enable the dyestuff or pigment to be transferred to the fabric at the printing stage.

Furthermore, the thickening agent must not break down during steaming or any other dye fixation process to such an extent that color' bleeding' occurs; the thickening agent must be removed entirely from the fabric during the washing-off treatment given to the printed fabric with dye-stuffs. One more requirement is that the thickening agent must be suitable, compatible with all the other components in the printing paste, and it must not be too expensive (W.Clerk 2004). A handy feature of modern thickening agents is their ability to be dissolved in cold water with the aid of a high-speed stirrer. In preparing thickening agents for use with a particular range of dyestuffs, it is often advantageous to incorporate assistants and other chemicals necessary to fix the dyestuff. An additional property of some thickenings is their ability to be coagulated by alkaline solutions, particularly where borax is present. Borax is used to aid dyestuff fixation in a two-stage process and prevent dyestuff bleeding or spreading after printing on fabric. Suitable dyes, pigment, and thickener selection are vital. Otherwise, an effort is taken for the printing that is spoiled.

For this natural study, source of dye, natural thickener, different metallic salts were used to increase the fastness of the dye. The experiment was carried out by considering objective extraction of pigment from the orange stalk of parijataka flowers, different optimization concentrations of guar gum, the time required for dye transference from gum phase to fabric phase, assessment of handle of printed fabric, the effect of mordants on dye fixation and evaluation of colorfastness properties of block

printed fabric.

Advantage of this study

Synthetic printing thickener is manufacture on a chemical base, and acrylic paints were used for printing to show the students in the laboratory, such as block printing, marble printing, and hand screen printing. The students should be to foot stand and start small scale businesses to prepare handkerchiefs, pillow covers, table mats using easy printing techniques, low cost, and more production to earned money. However, it was observed that synthetic printing thickener and acrylic paint bottle after use, the remaining thickener become hard, cannot be dissolved in any solvent and unable to converts into a solution for reutilization for printing. If thick acrylic paints were used for the printing, spoiled block and misprinting were noticed on the fabric. Hence a natural thicker "guar gum" was used for hand block printing. As it easily dissolves in water, no chemical is required for dissolving; if guar gum is dried, it is redissolved in the normal water for use and easily removed from the surface of the printed fabric by washing. It is advantageous compared to the chemical base printing thickener and is readily available in the market at a low cost

Materials and methods

Selection of thickener

Natural thickening agent guar gum was selected because it easily dissolves in water and easily removed during washing, and it is nontoxic. It is used in food items in bakery products, and it was purchased at the rate of Rs 90/ kilogram.

Selection and preparation of fabric

The cotton grey fabric of plain weave 2x1 weave was selected for hand block printing. The cotton grey fabric was prepared for printing by desizing, scouring, bleaching, and pressed with a hot iron to remove wrinkles to avoid the miss printing. Cut pieces of fabric 10 x10 inches in size for conducting block printing trials.

Dye source

The orange colour stalk of parijataka flowers was selected because it contains orange colour pigment. The botanical name of parijataka is Nyctanthes arbora tristis belonging to the family oleacese parijataka, a fabulous plant with high medicinal value. It is commonly known as harsinghar, parijataka in Hindi, night jasmine in English, parijataka flowers are white in colour with small size like jasmine of a short stalk of orange colour.

Collection and preparation of dye source

Flowers of parijataka opened in the early morning and dropped down. Flowers collected in the morning, the orange color stalk was separated from the white petals, and the size of stalk size is 1 to 1.5 inches, and it is tube-like with diameter is about 0.15 inch and dried in the shade and stored in the plastic tins for further research work.

Extraction of pigment

The dried orange colour stalk of parijataka flowers were crushed by hand and made into powder. 50 gm powder was added to the 500 ml of water and allowed to boil slowly for about 20 minutes as per the standardized time scale. The extracted pigment was strained, and the volume of extract was reduced in the concentrated form of about 150 ml; the concentrated extract was allowed to cool at room temperature and used for the preparation of printing paste with guar gum.

Mordant

Metallic salt was selected, such as alum, aluminum ferrous sulfate, copper sulphate, and ferrous sulfate. Post mordanting method was used for dye fixation and the development of different colour shades.

Printing table

Printing bed was prepared, several layers of blankets were carefully laid on the table and covered with a sheet of waterproof fabric. The cloth ten x ten inches was spread out on the table and fixed tightly by head pinning. Care to be taken that no movement of the cloth occurs during the printing operation.

Selection of wooden block

A flat, smooth surface square shape wooden block of size 3x3x3 inches and also for uniform application of dye paste on fabric.

. Preparation of printing paste pad

The printing paste pad was prepared by using soft old cotton fabric was folded four times and placed in an open mouth bowl of plastic, and dye paste was poured on the fabric, and dye paste was allowed to be absorbed entirely by the fabric. The wooden block was pressed on the printing paste pad and paste was stamped on the surface of the fabric.

Standardization concentration of guar gum for sharp printing

Selected thickening agent guar gum powder was taken in different concentrations as 4 gm, 6 gm, 8 gm, 10 gm, 12 gm, 14 gm in separate beakers. A constant amount of 20 ml concentrated extract of parijataka flower pigment was added in each beaker for preparation of printing paste and stirred carefully for avoiding lumps formation and kept for setting. Block printing carried with each concentration of guar gum printing paste and dried samples in place. Evaluation of printed sample for sharp print outline and a suitable concentration of guar gum thickener that developed sharp outline after printing was noted.

Printing process and drying of samples

With standardization concentration of guar gum of 8 gm and pigment extract of parijataka, 20 ml mixed and printing paste was made. Block printing was carried out on selected fabric and allowed to dry on printing table on selected time scale such as 30, 45, 60, 75, 90, and 105 minutes and samples washed to remove gum layer. The correct time scale for transfer of pigment from thickener phase to fabric phase was found out through measurement of color strength using Tinctometer color strength rating was noted.

Steaming of block printing samples

The role of steam is to achieve higher color yield and a higher degree of colour fastness. Steaming ensures an adequate amount of penetration of pigment molecules in the fiber of the fabric. For increasing colour fastness of

block printed samples was carried out by the normal steaming process. A metal strainer was placed over an aluminum vessel in which boiling water was boiling, and dried printed sample was placed on a strainer, and steam vapours passed through the printed sample. The steaming process was carried out in about 5 to 12 minutes, as per W. Clark (1987). After steaming, the printed sample was washed to remove the printing paste layer and surplus unfixed dyestuff and dried in the shade.

Evaluation of steam sample

Washed block printed samples were evaluated for colour strength, and the developed color on fabric was identified by matching the obtained shade with the shade card.

Dye fixation using mordants

Steam-treated block printed samples were mordanted using the post-mordanting method. The standardized concentration of selected mordants were alum (6gm), AlFeSO4 (8gm), FeSO4 (8 gm), and CuSO4 (6 gm). Mordants were dissolved in the warm water, and printed samples were soaked in the acidic solution for the dye fixation by a standardized mordanting time scale of 20 minutes. Moreover, the change in colour shade due to metallic salt treatment was identified by a colour match with shade card, and colour strength was measured using colour measuring instrument Tinctometer, and the colour rating was noted.

Evaluation of sample for handle and sharp print

Mordanted and without mordanted samples were evaluated visually for uniformity of colour, sharpness of outlines & overall appearance. Assessment of handle was carried out by sensory evaluation by touch and crumpled sample in hand for the feel. Furthermore, an assessment scoring was given as per the grading and rating such as excellent (5), very good (4), good (3), fair (2), and poor (1) with the panel of 30 judges comprised of textile experts and research scholars.

Testing of colour fastness properties of block printed samples

Mordanted and without mordanted samples were tested for colour fastness properties such as washing, rubbing and friction using Crokometer, hot pressing (hot iron), sunlight fastness and perspiration. Fastness rating was measured as per AATCC (American Association of Textile Chemist and Colourists). Colour fastness rating was express by numerical number as 5 to 1 and grading as excellent to poor, respectively.

Results and Discussion

Extraction of pigment from the orange stalk of parijataka flowers

The orange stalk of parijataka flowers contains orange pigment. It was found that pigment is easily dissolved in water; the colour of the extract is visible dark orange and in the combination of yellow and red pigment. Colour yield showed by colour strength rating as per the Tinctometer was recorded as 30Y10R. 'Y' is indicated as yellow colour & 'R' indicated red pigment present in the extract. Yellow pigment (30) was more as compared to red (10). Results revealed that 20 minutes was found to be sufficient for the extraction of pigment.

Table.1. Standardized conditions for block printing

S. No.	Standardized printing conditions		Colour strength
1	Time for extraction of pigment	20 minutes	30y10R
2	Standardized quantity of guar gum	8 gm	
3	Standardized quantity of extracted pigment	20 ml	
4	Standardized time for mordanting	20 minutes	
5	Standardized time for steaming	10 minutes	

Table. 2. Optimization of different concentrations of guar gum for block printing

S. No.	The concentration of guar gum /20ml of extract	An evaluation printed samples for sharp/spreading colour	Uniformity of colour	Handle fabric Soft /stiff
1	4 gm	Colour spreading	Not uniform	Soft handle
2	6 gm	Colour spreading	Not uniform	Soft handle
3	8 gm	Sharp printing	Uniform	Soft handle
4	10 gm	Sharp printing	Uniform	Stiff handle
5	12 gm	Colour paste not transferred from block	Not uniform	Stiff and harsh
6	14 gm	Colour paste not transferred from block	Not uniform	Stiff and harsh

Table. 2. illustrates the utilization of different concentrations of guar gum with the pigment of parijataka and block printing carried out on the cotton fabric. It was observed that 8 gm concentration and consistency of guar gum printing paste produced very softly smoothly stamped and transferred of printing paste on the surface of the fabric. The result showed that the printing paste was uniformly spread and sharp outlines of a block were visible, overall appearance was good, and no spreading of printing paste was noted before drying samples. As the concentration of guar gum increases from 10 gm to 14 gms, it was found that colour paste was not appropriately transferred from block to fabric and miss printing was observed because of thick printing paste. At the lower concentration of guar gum, 4gm and 6gm printing paste used for printing, spreading of colour from the block margin was noticed because the consistency of printing paste was thin and liquid. Hence, the Table showed that an 8 gm concentra-

tion of guar gum was suitable for block printing on cotton fabric.

Table 3. Time required for the absorption of pigment in the fiber of the fabric

S. No.	Concentration of 8 gm guar gum/20ml of extract	The time needed for drying the printed sample	Tinctometrically colour strength rating	Colour shade obtained & identify matching with the shade card
1	8 gm	30	10Y5R	light yellow
2	8 gm	45	12Y5R	light yellow
3	8 gm	60	13Y5R	dark yellow
4	8 gm	90	15Y8R	orange
5	8 gm	105	15Y8R	orange
6	8 gm	120	15Y8R	orange

Y- yellow, R-red

Table.3. showed that time is required for the absorption of pigment in the fiber of the fabric. Block printing was done on six samples with an optimized guar gum 8 gm and parijataka pigment 20ml. The samples get washed after 30, 45 and 60 minutes, and colour of the samples is evaluated visually. Changes were noticed in the colour shade from light yellow to dark yellow with colour strength ratings as 10Y5R, 12Y5R, and 13Y5Rrespectively. As the drying time was increased up to 90 minutes, a higher colour strength rating 15Y8R was recorded, and orange colour was observed. Further, it was observed that the colour strength rating was constant when drying at 105 to 120 minutes.

Table 4. Dye fixation using of parijataka pigment using selected mordants

S. No.	Mordants (10gm)	Tinctometrically colour strength rating	Colour shade identify matching with the shade card	Colour shade obtained & identify matching with the shade card
1	Without mordanted	15Y5R	Orange	light yellow
2	Alum	20Y8R	Dark orange	light yellow
3	AlFeSO4	15Y8R2B	Dry leaf brown	dark yellow
4	FeSO4	25Y15R5B	Brown	orange
5	CuSO4	10Y8B	Light peseta-green	orange

Y- yellow, R-red, and B- blue

It was observed from Table .4 that the colour strength rating was increased from 15Y5R to 20Y8R when alum used for dye fixation colour shade was also noticed as dark orange. AlFeSO4 mordant was found to be effective and changed the dark orange colour into dry leaf brown colour with colour strength rating 15Y8R2B and FeSO4 mordant used fixation of pigment parijataka flowers record higher colour strength rating as 25Y15R5B and obtained brown colour. When copper sulphate used for mordanting (dye fixation) developed light peseta green colour with colour strength rating was noticed as 10Y8B. It can be concluded that all the selected mordants were suitable for the development of various color shades.

Table. 5 Testing of colour fastness properties of cotton fabric block printed with parijataka pigment

S. No.	Colour fastness rating					
	Mordants/	Washing	Sunlight	Hot pressing	Perspiration	Rubbing
1	Without mordanted	2	2	2	2	2
2	Alum	4	4	4	4	4
3	AlFeSO4	5	5	5	5	5
4	FeSO4	5	5	5	5	5
5	CuSO4	1	1	1	1	1

Excellent-5, Very good-4, Good-3, Fair-2, Poor-1

It was observed from Table. 5. that colour fastness properties of parijataka pigment block printed sample of without mordanted samples exhibited fair colour fastness with fastness rating 2. It was observed that alum, aluminum ferrous sulphate, and FeSO4 mordanted sample colour fastness properties were found to be excellent to good with colour fastness ratings as 5 to 4, respectively. Copper sulphate mordant used for dye fixation developed light peseta green colour, and fastness properties were poor with colour fastness rating 1. It was clear from the result that alum, AlFeSO4, and FeSO4 mordants (metallic salts) were effective in making the color permanent of parijataka pigment and for the development of different colour shades.

Conclusion

It can be concluded from the study that guar gum is the cheapest thickener and has high viscosity. A lower concentration of guar gum thickener was good for transferring dye particles from gum phase to fabric phase and on a higher concentration of guar gum showed miss printing. It is suitable for block printing because it does not react with natural pigment nor with cotton fabric. The pigment of parijataka is easily dissolved in water, non-toxic, has medicinal value, and pigment quickly penetrates the fabric's fiber and develops an attractive orange color shade. All selected mordants alum, AlFSO4, and FeSO4 were effective for dye fixation and developed attractive color shades as dark orange, dry leaf brown, and brown. Parijataka flowers are the west material available free of cost and suitable for block printing on cotton with natural thickening agent guar gum.

Legumes of guar

Seeds of guar Guar gum

Dry and fresh orange stalk of parijataka

Flowers of *Parijataka*

Mordants used	Colour shade developed
Alum	orange
AlFeso4	dry leaf brown
Feso4	brown
Cuso4	light peseta green

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