Himachal Journal of Agricultural Research 44(1&2) : 75-79 (2018)

Bidens pilosa: a favourable natural colourant for cotton fabric printing

Sapna Gautam* and Archana Sharma
Department of Textiles and Apparel Designing, College of Home Science
CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur-176 062, India.
*Corresponding author: gautams88@yahoo.com

Manuscript Received: 02.11.2018; Accepted: 18.12.2018

Abstract

In the present study colour extracted from *Bidens pilosa* was utilized for block and screen printing of cotton fabric. *B. pilosa* is a small bush, abundantly found as a weed so an attempt was made to extract colour from this weed and utilize for natural printing. As thickener is a basic requirement for printing of any basic fabric so mango seed starch was used as natural thickener. To enhance printing impact on fabric, ferrous sulphate and stannous chloride were used as mordant and it was observed that mordant enhanced the dye/colour penetration and fixation. Good colour fastness properties of printed samples were observed.

Key words: Printing, *Bidens pilosa,* mango kernel starch, cotton, visual evaluation, colour fastness.

Natural colorants are emerging globally, leaving synthetic colorants behind in the race, due to the realisation that these are safer and eco-friendly in nature. In India dyes from natural sources have an ancient history and can trace their roots to antiquity. In this context, wildly available natural colourant i.e. *Bidens pilosa* was harnessed as dye source with mango kernel gum for printing cotton fabric. Printing of fabric is a creative and lucrative art nurtured and patronized through centuries. In printing, designs and colours form an artistic expression to embellish the fabric. Indian textiles are greatly valued and sought after for their colours and enduring qualities. Natural dyes and gum for printing textiles can play a major role to exhibit better bio-degradability and generally have a higher compatibility with environment. 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. The objective of present study is towards eco-friendly processing of textiles by using natural dye and gum from mango kernel for printing on cotton fabric. The natural gum and *B. pilosa* dye were utilized for block and screen printing of cotton fabric.

Materials and Methods

Selection of fabric: Plain white cotton fabric procured from local market was desized in lukewarm liquid detergent solution (2g surf/ezee in 100ml by wt. of fabric) for 30 minutes, washed, dried and ironed. Desized fabric was then treated with myrobalan solution before printing for better colour fixation. For this, the myrobalan solution was prepared by soaking myrobalan powder (30% by weight of fabric in water for overnight by taking material liquor ratio 1:20. The myrobalan solution was filtered through 2-3 layers of fine muslin fabric. The fabric was soaked in the filtered myrobalan liquor for three hours employing material to liquor ratio of 1:30.

Selection of dye: In the present study, *Bidens pilosa*, a

***B. pilosa* (*Lumb*)**

common weed in and around areas of Palampur, district Kangra, Himachal Pradesh was used as a source of natural colourant for natural printing of cotton. *B. pilosa* found abundantly in Himachal Pradesh and is commonly known as '*Lumb*' – weed, growing widely throughout the northern hilly terrain. It is an erect, perennial herb widely distributed across temperate and tropical regions. *B. pilosa* is either glabrous or hairy, with green opposite leaves that are serrate, lobed or dissected. It has white or yellow flowers and long narrow ribbed black seeds. It prefers moderately dry soil with full sun. However, it can grow in arid and barren land from long to high elevation. *B. pilosa* is herbaceous bush with slight aromatic odour, growing wildly in damp places and hindering the growth of superior vegetation belonging to the family *Asteraceae* (Rana *et al.* 2014). It is an erect, simple or much-branched annual or perennial herb and grows approximately 60-90 cm tall. For extracting colour; bushes of *B. pilosa* were dried in shade and grounded to powder for utilization as a dye source during printing of cotton fabric.

Extraction of dye and preparation of colour concentrate: Dye was extracted from *B. pilosa* bushes using recipe standardized under AICRP-research work at college of Home Science CSKHPKV Palampur. *B. pilosa* powder (5g powder) was boiled for 45 minutes in aqueous medium. After 45 minutes extract was sieved and kept on heating mental for boiling till remained 50-60 ml. Again concentrate was sieved through double layered muslin cloth to get clear extract so that sticking of minute dye particles on fabric can be avoided during printing. The solution was cooled and further used for preparation of printing pastes.

Natural thickening agents and preparation of gum: Thickeners used in textile printing are high molecular weight compounds and provide viscous paste with water. These impart stickiness and plasticity to the printing paste so that paste can be applied to fabric surface without spreading and capable of maintaining the design out lines even under high pressure. In present study, mango kernel starch was procured and utilized as natural thickening agent. Mango (*Mangifera indica* Linn.) is one of the most important tropical fruit in the world. It is cultivated and grown vastly in many tropical regions and widely distributed in the world. After consumption or industrial processing of fruits, considerable amounts of mango seeds are discarded as waste which approximately account for 35 – 55 per cent of the fruit depending on the variety (Puravankara *et al*., 2000). Therefore the utilization of mango by-products especially mango seeds may be an economical way to reduce the problem of waste disposal from mango processing. Following the same objective, mango kernel seed powder was procured and utilized as thickener or binding material for natural printing of cotton fabric. Starch of selected concentration was mixed/ soaked (5.0 g) in 20 ml of luke-warm dye extract separately and kept the mixture undisturbed for 15 minutes. Then added the measured amount of dye concentrate and heated the mixture till the semi liquid translucent consistency achieved. Remove the paste from heat. The required mordant was mixed in 5ml. of luke-warm dye extract again. Added 10-20 ml of dye extract in it and mixed thoroughly.

Mordant used: To optimize the mordant concentrations, mordants were tried at different concentrations as metal salts provide exhaustion and fixation of printing paste to textile materials. In natural dyes colour change expectations is somewhat high and effect of mordant type is of great importance for the shade of the colour (Samanta and Agarwal 2009). Stannous chloride (1.0 per cent) and ferrous sulphate (1.0 per cent) was used for printing.

Preparation of printing paste: The optimized printing recipe was used for preparation of printing paste. The mordants (Stannous chloride-1.0% and $FeSO_4$-1.0% by wt. of above prepared printing paste) were dissolved separately with 10 ml of lukewarm dye extract for smooth printing paste and added to the prepared mango seed starch paste with thoroughly mixing. Dye concentrate was again added slowly till the smooth consistency of paste was obtained using continuous heating at low temperature.

Printing Technique: Printing was done on de-gummed cotton fabric using blocks and screen.

Block printing method

Placed the de-sized cotton / de-gummed cotton and silk fabric on the printing table. Scattered the printing paste uniformly on the double layered foam on the tray box. Selected the block for printing and touched it with printing paste. Pressed the block on fabric. After hard pressing the block on the sample fabric the block is put

off from the fabric. Dried the fabric under shade. Steamed the fabric using standard method and after treatment with salt, alum, vinegar and sodium carbonate.

Screen-printing method

The fabric is placed on the printing table. Screen is placed on the sample fabric. Spread the printing paste on screen and then spread this printing paste on fabric with the help of smooth wooden striker with slight pressure, so that the dye particles can penetrate through the screen perforation. Finally the printed fabric can be obtained.

After treatment of printed samples

Dried printed samples were subjected to steaming for 45-60 minutes and after that they were treated with sodium chloride (5% by w.o.f.) to increase the depth of the shade. Treated samples were washed to remove the thickener, unfixed dye and mordant. The printed samples were washed in running water. Finally they were squeeze and dried under shade.

Visual evaluation and colour fastness properties: Printed samples were got evaluated by panel of judges for different parameters like depth of colour, evenness in printing and sharpness of printing.

Colour fastness properties like washing, sun light, rubbing (dry and wet) and perspiration (acidic and alkaline) of printed samples was carried out using standardized test methods of IS: 3361-1979, IS: 686-1957, IS: 767-1956 and IS: 971-1956, respectively.

Results and Discussion

Visual assessment of printed samples: The data regarding visual evaluation of block and screen printed samples on the basis of depth of color, evenness of print, sharpness of print and overall evaluation using *B. pilosa* dye, mango seed starch and without or with two different mordants has been shown in table1.

Results revealed that in case of without mordant, block (3.0) and screen (2.97) printed samples aggregate WMS was observed as less, as compared to mordanted samples. Maximum WMS was observed as 3.57 in case of screen printed samples using 1 percent ferrous sulphate mordant, followed by 3.45 WMS for block printed samples with 1 per cent ferrous sulphate mordant. In case of stannous chloride mordant aggregate WMS was calculated as 3.37 for screen printed samples and 3.32 for block printed samples.

Comparison of colour fastness of cotton printed samples using natural dye i.e. *B. pilosa* and mango seed gum was studied and slight variation in case of without mordant was observed and it could probably be due to dye material extraction in aqueous medium whereas in case of mordanted samples colour fastness was better. Repeated experimentation showed that the role of the mordant is important in imparting colours and fixation of colour on fabric e.g. stannous chloride imparted the light yellow to mustard colour to the samples whereas addition of ferrous sulphate turned the colour of samples dark brown to black. The effect of mordant is of great importance for the shade of the colour as stated by Samanta and Agarwal (2009). Colour staining was observed as maximum in case of cotton fabric as compared to wool.

Table 1. Visual evaluation of cotton samples printed with *B. pilosa* dye using mango seed gum

N=10

Printing Technique	Depth of color (WMS)	Evenness of print (WMS)	Sharpness of print (WMS)	Overall (WMS)	Aggregate (WMS)
	Control (Mango seed gum 5%) without mordant				
Block	2.9	3.3	2.6	3.2	3.00
Screen	2.7	3.3	3.0	2.9	2.97
	Mango seed gum (5%) with $FeSO_4$ (1%)				
Block	3.2	3.7	3.5	3.4	3.45
Screen	3.4	4.0	3.4	3.5	3.57
	Mango seed gum (5%) with Stannous chloride (1%)				
Block	3.3	3.7	3.0	3.3	3.32
Screen	3.2	3.5	3.3	3.5	3.37

Table 2. Evaluation of fastness properties of cotton samples printed with *B. pilosa*dye N=10

Gum conc. (5 %)	Colour fastness grades													
	light	Washing			Rubbing				Perspiration					
		CS			Dry		Wet		Acidic			Alkaline		
		cc	w	c	cc	cs	cc	cs	cc	cs		cc	cs	
										w	c		w	c
Printing with mango seed gum without mordant)														
Block	6	3	4	4/5	5	4/5	4	4/5	4	4/5	3/4	3/4	4/5	5
Screen	5	3	3/4	4/5	5	4	4	4	3/4	4/5	3/4	3	3/4	4
Printing with mango seed gum using ferrous sulphate 1.0% as mordant)														
Block	5	4/5	3/4	4/5	5	5	4/5	4	4	4/5	4	4/5	5	4/5
Screen	4	4	4/5	4	5	5	4/5	4/5	4	4/5	4	4	5	4/5
Printing with mango seed gum using stannous chloride 1.0% as mordant)														
Block	6	4/5	4	5	5	4/5	5	4	4/5	5	4	4/5	4	4/5
Screen	4	4	4/5	5	4/5	4	4/5	4	4	4/5	4	5	4	4

cc- colour change, w-wool, c-cotton, cs – colour stain

Light fastness

Light fastness ratings were given as per blue wool standards. Light fastness was measured by the fading of dyed or printed samples which is influenced by chemical, physical state and concentration of dye, nature of the fibres and mordant types (Cristea and Vilarem 2006). In the present study printed samples were exposed to ultra violet light for 5 hrs, 10 hrs, 15hrs and so on upto 72 hrs using Digi light and data obtained showed that in case of without mordant samples, 6 (Block) to 5 (Screen) hedonic grades were observed after exposing the printed samples in Digi light whereas in case of ferrous sulphate and stannous chloride light fastness grades were found as 5 (Block) and 4 (Screen) for printed samples using mordant ferrous sulphate and 6 (Block) and 4 (Screen) for printed samples using mordant stannous chloride. All the samples showed fair (6) to good (4) light fastness rating. It means block as well as screen printed cotton samples had average to good resistance towards light.

Washing fastness

Samples tested for washing, rubbing and perspiration fastness were assigned rating for change in colour and degree of staining on standard fabric with the help of grey scales.

Data regarding washing fastness indicate that the washing fastness to samples printed with *B. pilosa* dye and mango seed gum, ferrous sulphate mordant was very good as there was negligible change in colour (4/5) and no colour staining (5) on naturally printed cotton fabric was observed. In case of printing with ferrous sulphate and mango seed gum, slight change in colour was observed (Babel *et al*. 2015).

Crocking fastness

Crocking is the transfer of colour from a coloured textile to another fabric surface through the rubbing process. The extent of rubbing may be influence by the moisture, as many textiles transfers more colours when wet (Babel and Gupta 2013). In case of present study, rubbing fastness for both without mordant as well as with both mordants for dry rubbing, was observed as good to excellent (4/5 – 5) whereas in case of wet rubbing good to very good results were observed (4 – 4/5). In case of wet rubbing colour staining was more prominent as compared to the colour change.

Perspiration fastness

Shenai (1980) stated that dyes should have good perspiration fastness. Perspiration of certain people is acidic in nature and the others have alkaline. When people wearing coloured garments perspire, a part of dye coming into contact with the perspiration might

stain other garments or skin of the wearer. The perspiration fastness grades ranged between fair to excellent (3/4 – 5) for all the samples in both alkaline and acidic mediums. Slight colour staining was also observed which was observed as maximum on cotton fabric as compared to silk or wool. As per grey scale standards; colour change in alkaline medium was more prominent (3) for without mordanted screen printed samples and 3/4 for block printed samples.

Cost

Cost was worked out for printing one meter of cotton fabric by calculating the cost of natural dye, thickener, chemicals and excluding the labour charges as well as cost of fabric. The fabric printed with 5 per cent *B. pilosa* dye powder and 5 per cent mango seed starch using 1 per cent ferrous sulphate and stannous chloride as mordant cost approximately Rs. 10-12.

Product development from naturally printed fabric

On the basis of standardization and optimization of conditions for printing with *B pilosa* dye, mango seed gum (5.0%) using Stannous chloride (1.0%) and ferrous sulphate (1.0%) as mordant, printing was carried out for block and screen printed product development like cushion cover, hot pads, table mats, coasters etc.

Conclusion

It is evident from the results that cotton fabric can be successfully block and screen printed using mango seed gum and *B. pilosa* dye extract. The colour fastness properties of printed samples were also observed as good to very good. Hence, the implementation of natural thickening agents with natural dye source using block and screen printing is very much possible and can be commercialized and more emphasized in exporting in the domestic as well as international market which can play a significant role in improving the rural economy.

References

Rana Dipika, Haseeb UI and Masoodi Rashid. 2014. Ethno-botanical survey for wild plants in fringe villages around Shimla water catchment sanctuary, Himachal Pradesh, India. Journal of Applied and Natural Science **6 (2)**: 720-724.

Puravankara D, Bohgra V and Sharma RS. 2000. Effect of antioxidant principles isolated from mango (*Magnifera indica* L.) seed kernels on oxidative stability of buffalo ghee (butter fat). Journal of Science of Food and Agriculture **80:**522-526.

Samanta AK and Agarwal P. 2009. Application of natural dyes on textiles. Indian Journal of Fibre and Textile Research (IJFTR) **34:**384-399.

Cristea D and Vilarem G. 2006. Improving light fastness of natural dyes on cotton yarn. Dyes and Pigments **70:** 238-245.

Babel Sudha, Gupta Rupali and Mogra Dolly. 2015. Eco-friendly screen printing natural and indigenous Tickener–mango kernel and Cassia tora gum. Journal of Environment Science, Computer Science and Engineering & Technology **4 (2)**: 417-423.

Babel Sudha and Gupta Rupali. 2013. Block printing with dye concentrate of *Butea monosperma* flowers with gum extracted from waste mango kernel and *Cassia tora* seeds on cotton fabric. International Journal of Science and Research (IJSR) **6** (14): 337-360.

Shenai VA. 1980. *Technology of Textile Processing Technology of Dyeing.* Vol. VI. Bombay, Sevak Publication. p 444.