



Eco friendly Printing of Cotton Fabric with Natural Dyes and Printing Auxiliaries

SNEHA GARGI AND MEENU SRIVASTAVA

Maharana Pratap University of Agriculture and Technology, Department of Textiles and Apparel Designing, Udaipur - 313001

*Email: gargisneha5@gmail.com

Abstract : Concerns over the environmental and health hazards of using synthetic dyes, resulted in growing interest of using natural resources in textile printing sector. The artisans use different techniques and methods based on the availability of natural sources. A study was conducted to standardization of printing paste using three natural dyes Madder, Arjuna and Annatto were selected along with thickening agent *guar* gum powder, fixing agents chitosan, two mordants myrobalan and alum and cold pressed coconut oil as plasticizer to develop direct prints on cotton fabric. The natural dye was extracted by aqueous extraction method followed by ultra sonication of the dye extract. The two print paste combinations were developed with the combinations of two natural dyes and printing auxiliaries using standardized recipe. The screen printed cotton fabric samples exhibits very good to excellent colour fastness properties and the developed prints was found highly acceptable among consumers for use as home textiles.

Key words: Natural dyes, natural printing auxiliaries, screen printing.

The natural dyes has been used in India from thousands of years and is part of India's cultural identity. In ancient times, dyed textile were symbol of status. Natural dyes were extracted from a wide range of plant components. The yellow colour extracted from the stigmas of *Crocus sativus L.*, rhizome of *Curcuma longa L.*, while red colourants extracted from the root of *Rubia tinctorum L.*, and blue dyes from the leaves of *Indigofera tinctoria L.* are widely used as textile colourants (Uddin *et al.*, 2022). Few other natural sources used to extract dye are Madder (*Rubia cordifolia Linn.*), Tesu flowers (*Butea monosperma Lam.*), Annatto (*Bixa orellana Linn.*), Morinda (*Morinda citrifolia Linn.*), Henna (*Lawsonia inermis Linn.*), Sappan wood (*Caesalpinia sappan Linn.*), Barberry (*Berberis aristata Linn.*), etc. (Hamdy, 2021). Dyeing and printing is the process of colouring the textile substrate like fibres, yarn or fabric with the dyes to enhance the aesthetic value of fabric. Printing is an old art form date backs thousands of years. Traditionally, textile printing techniques categorized into two types *i.e.* direct and indirect

printing. The direct printing techniques is most popular method includes block printing, screen printing, digital printing, etc. whereas indirect printing technique includes resist printing, discharge printing, etc. (Yıldırım *et al.*, 2020; Abdelrahman *et al.*, 2020).

Direct printing also known as 'print-on' and consider as most common and easy printing technique in printing industry. The term direct printing symbolized that no previous mordanting or dyeing procedure was involved. In this the print paste come into direct contact with fabric surface without any additional treatment (El-Kashouti *et al.*, 2019).

To obtain better colour fastness characteristics, the dye stuffs incorporated in print paste with combinations of printing auxiliaries such as thickeners, fixing agents, etc. which influence the rheology of paste and serve as a transporting medium for dyestuffs and auxiliaries into the fabric. This minimizes the colour's spread outside of the fabric's design region and makes it possible for sharp and defined designs.

Though the use of natural dyes in dyeing industry has been increased in India but the use and research on natural dye and printing auxiliaries used for printing are little. Printing can be carried out with natural dye but the auxiliaries used to develop print paste like mordants, thickening and binding agents were synthetic. Hence, there is need to be focussed on the natural printing auxiliaries along with natural dyes for textile printing. To develop direct prints with enhanced fastness properties, the study was conducted on printing of cotton fabric using natural dyes and printing auxiliaries.

MATERIALS AND METHOD

Selection of natural dyes and printing auxiliaries

In order to develop eco friendly direct prints on cotton fabric, three natural dyes Madder, Arjuna and Annatto were selected. The natural printing auxiliaries like *guar* gum as thickening agents, alum and myrobalan as mordants, chitosan as fixing agents and coconut oil as plasticizer were selected for the present research work. The scouring of cotton fabric was carried out in order to remove impurities from the fabric to achieve uniform printing and proper penetration of printing paste.

Preparation of printing paste

The dye extract used to develop print

paste combination was extracted by aqueous extraction method followed by the ultra sonication of the dye extract. The print paste is developed using the combinations of dye extract and printing auxiliaries, guar gum powder, myrobalan, alum, chitosan and coconut oil. The mordants were directly incorporated in the print paste. The standardized recipe was used to develop print paste combinations.

The print paste combinations developed are as follows-

1. Madder dye + *guar* gum powder + myrobalan + alum + chitosan + coconut oil (PPC 01).
2. Arjuna dye + *guar* gum powder + myrobalan + alum + chitosan + coconut oil (PPC 02).
3. Annatto dye + *guar* gum powder + myrobalan + alum + chitosan + coconut oil (PPC 03)

After 18 hour, the prepared combinations further underwent for ball milling process for 30 minutes at medium speed in ball milling machine, in order to make the print paste consistency smoother. After ball milling process, the printing paste were ready to directly apply on the fabric surface.

Printing on the fabric

Screen printing technique was adopted for the study to develop direct prints on scoured



(PPC 01)



(PPC 02)



(PPC 03)

Table 1. Subjective evaluation of developed samples with three natural dyes

Print paste combinations	Parameters			
	Uniformity	Depth of shade	Sharpness of design	Mean Score and SD
PPC 01	4.3	4.3	4.5	4.37 ± 0.115
PPC 02	4.5	4.5	4.6	4.53 ± 0.058
PPC 03	4.4	4.4	4.6	4.47 ± 0.115

(PPC = Print Paste Combination, PPC 01 = Madder dye print paste combination, PPC 02= Arjuna dye print paste combination, PPC 03= Annatto dye print paste combination)

Table 2. Colour fastness of developed printed samples using natural dyes

Print paste combination	Parameters				
	Wash fastness		Rubbing fastness		Light fastness
	CC	CS	Dry rubbing	Wet rubbing	
PPC 01	4	4	4/5	4	6
PPC 02	5	4	5	4	7
PPC 03	4	3	4	3	5

(PPC = Print Paste Combination, PPC 01 = Madder dye print paste combination, PPC 02= Arjuna dye print paste combination, PPC 03= Annatto dye print paste combination, CC = Colour Change, CS= Colour Staining)

Note - 1- Very poor, 2- Poor, 3- Good, 4- Very good, 5- Excellent, 6- Very good, 7- Excellent

cotton fabric. The cotton fabric was then printed by using combinations of developed print paste. For screen printing, the suitable amount of developed direct print paste was poured on the screen mesh and with the help of squeegee the print paste was transferred on the fabric. After printing the samples were kept for 24 hrs. at room temperature.

After treatment

The screen printed samples were then dried, fixed by steaming process and rinsed in cold water. The developed samples were assessed for subjective and objective evaluation on various parameters.

RESULTS AND DISCUSSION

The printed samples were evaluated by subjective evaluation on various parameters like depth sharpness and uniformity of design and for colour fastness to washing, rubbing and light.

Subjective evaluation

For subjective evaluation, a panel of ten experts of Textiles and Apparel Designing assessed the printed samples on selected

parameters such as depth of shade, uniformity of design and sharpness of design. The 5 point rating scale were used to evaluate the printed samples. The mean score obtained by the samples are shown in Table 1.

The samples printed with PPC 01 shows overall 4.37 ± 0.115 mean and SD in terms of uniformity of design, depth of shade and sharpness of the design whereas, PPC 02 exhibits 4.53 ± 0.058 and PPC 03 shows 4.47 ± 0.115 mean and SD.

Objective evaluation

By using standard test procedures, the samples were evaluated for the wash, rubbing and light fastness properties.

The screen printed cotton fabric samples printed with PPC 01 exhibits good wash, rubbing fastness and good to excellent light fastness properties whereas, the samples printed with PPC 02 exhibits excellent wash rubbing and light fastness properties. The samples printed with PPC 03 exhibits very good wash rubbing and light fastness properties. The samples printed with Arjuna dye print paste combination exhibits excellent colour fastness properties on all

parameters. The printed samples were found to be highly appreciable by consumers to develop home textiles products. (Table 2.)

CONCLUSION

Findings conclude that the screen printed cotton fabric samples using Annatto Arjuna and Madder as natural dyes exhibits better colour fastness properties. The print paste developed with combinations of printing auxiliaries were standardized. The outcome of the research in terms of developed direct prints using standardized printing paste recipe of selected natural dyes and printing auxiliaries had good potential for commercialization in the textile printing sector.

REFERENCES

- Abdelrahman, M., Wahab, S., Mashaly, H., Maamoun, D., and Khattab, T.A. 2020.** Review in textile printing technology. *Egyptian J. Chem.*, **63**: 3465-79.
- Chattopadhyay, S.N., Pan, N.C., and Khan, A. 2018.** Printing of jute fabric with natural dyes extracted from manjistha, Annatto and ratanjot. <http://nopr.niscpr.res.in/handle/123456789/45028>.
- El-Kashouti, S.M., Elhadad, K. Abdel-Zaher 2019.** Printing technology on textile fibers: Review, *J. Text. Colour. Polym. Sci.* **16**: 129-38.
- Hamdy, D., Hassabo, A.G., and Othman, H. 2021.** Recent use of natural thickeners in the printing process. *J. Textiles, Colouration and Polymer Sci.* **18**: 75-81.
- Mansour, R., and Ben Ali, H. 2023.** Exploring chitosan as an eco-friendly agent to improve sustainable dyeing properties of Cotton fabric dyed with (*Opuntia ficus-Indica L.*) fruit peel and its UV protection activity. *J. Natural Fibers*, **20**: 2134263.
- Ojha, D., Deodiya, S. and Purwar. R. 2019.** Printing of Lyocell fabric with *Rubia cordifolia* and *Acacia catechu* using Guar gum and Chitosan as Thickening Agent, *Indian J. Tradit. Knowledge*, **18**: 615-20.
- Panda, H. 2013.** A concise guide on textile dyes, pigments and dye intermediates with textile printing technology. *Niir Project Consultancy Services*.
- Sangamithirai, K., and Vasugi, N. 2023.** Eco friendly printing on Cotton fabric with *Peltophorum pterocarpum* flowers. *Home Science*, **35**: 1.
- Savvidis, G., Karanikas, V., Zarkogianni, M., Eleftheriadis, I., Nikolaidis, N., and Tsatsaroni, E. 2017.** Screen-printing of Cotton with natural pigments: Evaluation of colour and fastness properties of the prints. *J. Natural Fibers*, **14**: 326-34.
- Uddin, M. A., Rahman, M. M., Haque, A. N. M. A., Smriti, S. A., Datta, E., Farzana, N. and Sayem, A. S.M. 2022.** Textile colouration with natural colourants: A review. *J. Cleaner Prod.* 131489.
- Yıldırım, F. F., Yavas, A., and Avinc, O. 2020.** Printing with sustainable natural dyes and pigments. Sustainability in the *Textile and Apparel Industries: Production Process Sustainability*, 1-35.

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