Chapter

Exploration of Bamboo Fabrics with Natural Dyes for Sustainability

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Abstract

The history of weaving and textile innovation follows the history of technological innovations and the evolution of socio-cultural issues in a stepwise manner. Currently, textiles and patterns are tools that characterize garments and define their unique aesthetics, becoming identity-making elements not only for a single product or a collection, but also for brands. By balancing a delicate equilibrium between brand heritage and zeitgeist, the Indian textile industry bases its success on the capability to reorganize creative processes to generate innovation, also thanks to new relationships among textile designers and their consumers. It is creating something new is the need of hour for the apparel industry and they are aware of it. By utilizing these new techniques for bamboo fabric, we can introduce some designs which will give unique look and increase the marketability of the product. Bamboo viscose, also known as regenerated bamboo, is a regenerated cellulosic fiber. In the last few years in the world market, more and more products from bamboo fibers have been appearing. It is marketed as having exceptional properties such as superior comfort and hand, as well as antimicrobial properties. Yarns of bamboo fibers provide the desirable properties of strength, high moisture absorbency, antimicrobial and antifungal, sheen and smooth close to silk, cashmere and glass fiber high breathability and thermo-regulating properties in textiles and made ups. The articles are designed and developed by natural dyeing and printing with hand block.

Keywords: bamboo fabric, natural dyeing, natural printing, hand block print

1. Introduction

Bamboo viscose, also known as regenerated bamboo is a regenerated cellulosic fiber. In the last few years in the world market, many products from bamboo fibers have been appearing.

It is marketed as having exceptional properties such as superior comfort and hand yarns of bamboo fibers provide the desirable properties of strength, high moisture absorbency, antimicrobial and antifungal, sheen and smooth close to silk, cashmere, glass fiber high breathability and thermo-regulating properties in textiles and made ups [1]. Shaw [2] currently, regenerated bamboo fibers are used in apparel including undergarments, sportswear, t-shirts and socks, this fiber will not cause skin allergies and its application in sanitary materials such as baby diaper, absorbent pads and sanitary towels. Bamboo fiber has found its way into the fashion world. In their collection, designers often replace more expensive materials like cashmere, silk and glass fiber by their bamboo equivalent [3, 4].

Bamboo has the fastest growth rate among the various types of renewable natural fibers, bamboo fabrics require less dyestuff than cotton fabrics in order to be dyed to the level desired, as they absorb the dyestuff better and faster and show the colour better [5]. The most important aspects of clothing is comfort properties like thermal resistance, air permeability, water vapor and liquid water permeability are critical for the thermal comfort of a clothed body. Comfort plays a vital role in the selection of apparel [12]. Bamboo fiber is more efficient than the cotton fiber as it needs less dying color and raw material to dye the fabric as per the required need. The natural dyeing solution was obtained by from rind of Vempadam Bark (*Ventilago madraspatna*) used for dyeing bamboo fabric. Fastness properties of the dyed sample were studied [6].

Zakrzewski [7] reported that cross-section of the bamboo fiber is covered with micro-holes giving the fabric better moisture absorption and ventilation. According to authoritative testing figures, apparels made from bamboo fibers are 1–2 degrees lower than normal apparels in hot summer. Apparel made from bamboo fiber is crowned as *air conditioning dress* [8].

Bamboo fibers are claimed to have some distinctive properties such as high moisture absorption, better drape and deep colour effect [9, 10]. Bamboo fiber are claimed to have unique properties such as inherent antimicrobial, UV-shielding properties without aid from petrol-derivative chemicals. These unique properties and the sustainable nature of bamboo fiber have started to attract consumers in the textile market, particularly due to the high price [11].

2. Objectives

1. Comparative study of natural dyed, printed bamboo and cotton fabrics.

2. Developed garments of the natural dyed and printed bamboo fabric according to "Fashion Trend."

3. Methodology

3.1 Material

Bamboo yarns were used count 1/64 Nm both side warp and weft direction.

3.2 Method

Bamboo fabric was developed on the handloom in 100 reed count, 2/dent of yarn with plain weave used bamboo yarns both side warp and weft. After manufacturing following process on bamboo fabric.

3.2.1 Natural dyeing and printing processes

3.2.1.1 Scouring

M:L—1:50
Time—60 min at 60–90°C temperature
Casting soda—5% (by weight of the fabric)
Common salt—2% by weight of the fabric (**Figures 1**–**3**).

Figure 1.
Scouring.

Figure 2.
Washing by fresh water.

Figure 3.
Drying in open air.

3.2.1.2 Mordanting

Dyeing of pre-mordant of bamboo fabric, pre-mordanting treatment was conducted using mordant. Bamboo fabric samples were pre-mordanted of bamboo was carried out with mordant at concentrations on the weight of fabric:

- *Brightening mordant*:

Alum (aluminum potassium sulfate): 25% by weight of fabric

Tin (stannous chloride): 3% by weight of fabric

Chrome (potassium dichromate): 1% by weight of fabric

- *Dulling mordant*:

Copper (copper sulfate): 3% by weight of fabric

Iron (ferrous sulfate): 5% by weight of fabric

At 60–90°C for 30–60 min with material to liquor ratio as 1:30. After mordanting the samples were rinsed in cold water to remove the excess of mordant and used for dyeing (**Figures 4** and **5**).

3.2.1.3 Preparation of dyeing processes

Dye solution was boiling for ½ h at 40°C and filter of the dye bath after that dyeing of the pre-mordanted samples was performed for 1 h at 30–40°C in an open bath beaker dyeing machine at 20:1 liquor to material ratio. The dyed samples were rinsed in cold water and dried in open air (**Figures 6–9**).

3.2.2 Preparation of printing processes

3.2.2.1 Mordanting of bamboo fabric

Mordanting of bamboo was carried out with mordant at concentrations on the weight of fabric alum (aluminum potassium sulfate): 25% at 60–90°C for 30–60 min with material to liquor ratio as 1:30. The mordanted fabric was squeezed and dried in open width form at 100°C for 5 min and then used for printing.

Figure 4.
Mordanting.

Figure 5.
Washing by fresh water.

Figure 6.
Dye solution boiling.

Figure 7.
Filter of the dye solution.

Figure 8.
Fabric dying in dye bath.

Figure 9.
Dyed and stitched garment.

3.2.2.2 Preparation of dye paste

All the dyes used were first converted to powder form. For natural dyes were first dried in an oven at controlled environment at 27 ± 2°C and RH 65 ± 2%, with at least 24 h at "equilibrium regain" and later grinded in mixer grinder. The powder so obtained was filtered through the 60 mesh nylon fabric. The fine powder of natural dye was used for printing (**Figures 10** and **11**).

3.2.2.3 Preparation of guar gum paste (print medium)

Guar gum being nonionic is best suited for textile printing was prepared using 5% of guar gum powder. The guar gum powder was sprinkled slowly in water with

Figure 10.
Mesh of the dye in water.

Figure 11.
Filter of the dye paste.

continuous stirring in order to prevent lump formation. The paste was stirred continuously at 90°C for 1 h. For preparation of 1% of print paste, 1 g of dye powder was first pasted with small quantity of water followed by addition of 99 g of guar gum stock paste. The mordanted bamboo fabrics were then printed with two strokes of squeeze, steamed at 100°C for 10 min. The samples were washed with water and then dried in air (**Figures 12–16**).

3.2.2.4 Block printing: preparations of blocks include designing technique and motifs

See **Figure 17**.

3.2.3 Developed garments of the natural dyed and print bamboo fabric according to fashion trend

See **Figures 18–20**.

3.2.4 Comparative study of the bamboo fabric and cotton fabric

The results of the study are shown in **Table 1**.

Figure 12.
Mesh of the guar gum in water.

Figure 13.
Filter of the guar gum paste.

Figure 14.
Guar gum and dye solution.

Figure 15.
Preparation dye trey.

Figure 16.
Preparation of print trey with mixed dye and guar gum paste.

Figure 17.
Printing by wooden blocks.

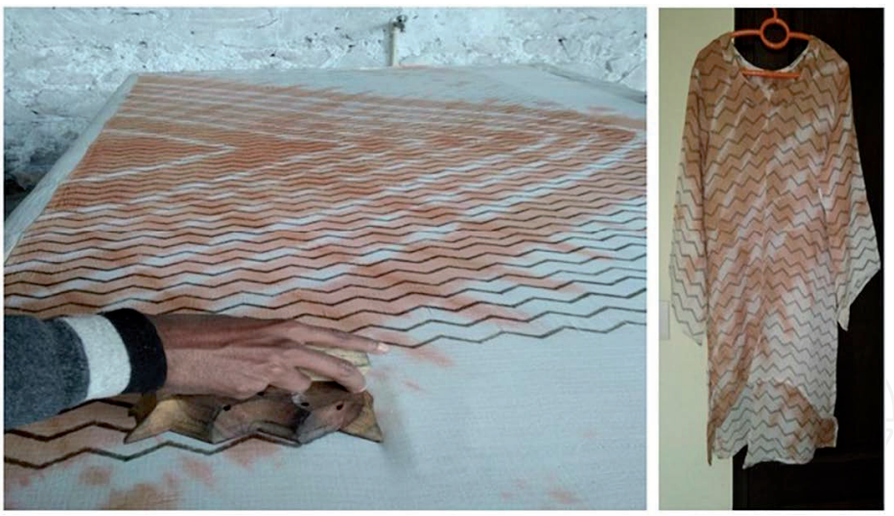

Figure 18.
Onion skin print on dyed fabric with pomegranate peel.

Figure 19.
Onion skin print on dyed fabric with sandal red.

Figure 20.
Indigo blue print on dyed fabric with purging nut.

S. N.	Species (Family Name)	Common Name	PH Value	Colour Obtained	Colour Application	
					Cotton	Bamboo
1.	Caealpinia Sappan	Sappan Wood	5-7	Jaipur Pink	Good	Very Good
2.	Punica granatum-(Lythraceae)	Pomegranate Peel	3-5	Mallow Gold	Fair/Good	Good
3.	Rheum Emido	Indian Ruharb	3-5	Apsara Yellow	Fair	Good
4.	Nyctanthes tristis (Oleaceae)	Night Jasmine	3	Prime Rose Yellow	Good	Very Good
5.	Indigoferatinctoria (Fabaceae)	Indigo	11-12	Indigo Blue	Good	Very Good
6.	Quercus Infectoria	Oak Tree Fruit	5	Gallnut	Good	Very Good
7.	Tagetes Erecta	Mari Gold	5	Sun Yellow	Fair	Good
8	Bixa Orellana	Annatto	9	Candy Orange	Very Good	Excellent
9.	Terminalia che	Myrobalan	5	Cedar Yellow	Good	Very Good
10.	Laccifer laca (keer)	Sheel Lac	5	Wine Red	Good	Very Good
11.	Rubia Cardifolia	Heart Leaved Madder Roots	5-7	Turkey Red	Good	Very Good
12.	Pterocarpus Sandal	Sandal Red	5	Barn Red	Fair/Good	Good
13.	Butea Monosperma	Purging Nut	5-6	Cuttack Silver	Fair/Good	Good
14.	Allium Cepa	Onion Skin	6-8	Onion Peel	Very Good	Excellent

Table 1.
Colour obtained with PH value of the natural dyes by cotton and bamboo fabrics.

4. Conclusion

The experimental research design was used keeping in view the objectives of the study. Pit handloom used by the weaver was employed for bamboo yarns were used to manufacture fabric; handloom bamboo fabric was selected for the study. Fourteen natural dyes used for dyeing and printing with alum mordent. A property such as washing fastness was determined by standard methods. Washing fastness was exhibited fair to excellent in **Table 1** [13]. It can be concluded that creating something new is the need of hour for the apparel industry and they are aware of it. Handloom bamboo fabric was used for apparel in this study considering its dye exhaustion properties. The study is successful innovative bamboo apparel products with natural dyes.

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References

[1] Lipp-Symonowicz B, Sztajnowski S, Wojciechowska D. New commercial fibres called 'Bamboo Fibres'—Their structure and properties. Fibres & Textiles in Eastern Europe. 2011;**19**(1):18-23

[2] Shaw M. Bamboo Fibers: A Review [Internet]. 2013. Available from: www.fibre2fashion.com [Accessed: 24 July 2013]

[3] Prakash C, Ramakrishnan G, Koushik CV. Effect of blend ratio on the quality characteristics of bamboo/cotton blended ring spun yarn. Fibres & Textiles in Eastern Europe. 2011;**19**(6):38-40

[4] Saravanan K, Prakash C. Bamboo fibres & their application in textiles. The Indian Textile Journal. 2007;**117**:33-36

[5] Sekerden F. Effect of fabric weave and weft types on the characteristics of bamboo/cotton woven fabrics. Fibres & Textiles in Eastern Europe. 2011;**19**(6):47-52

[6] Manimekalai G. Antimicrobial properties of bamboo of fabric finished with Vempadam bark (*Ventilago madraspantana*) extract. International Journal of Scientific and Engineering Research. 2018;**9**(12):2018

[7] Zakrzewski W. Nowe trendy: A możetak ... bambus? [Internet]. 2011. Available from: http://www.hike.pl/sklep/Nowe-trendy-bambus-sp-25.html

[8] Rodgers M. Bamboo Clothing [Internet]. 2010. Available from: www.fibre2fashion.com [Accessed: 30 April 2010]

[9] Bamboosa. 2009. Available from: https://www.bamboosa.com/boombosa.php?PID=13 [Accessed: 14 January 2009]

[10] Bambrotex. 2008. Available from: http://www.bambrotex.com/second/anti_UV.htm [Accessed: 17 December 2008]

[11] Waite M. Sustainable textiles: The role of bamboo and a comparison of bamboo textile properties. Journal of Textile and Apparel, Technology and Management. 2009;**6**(2):1-21

[12] Chidambaram P, Govindan R. Influence of blend ratio on thermal properties of bamboo/cotton blended woven fabrics. Silpakorn University Science and Technology Journal. 2012;**6**(2):49-55

[13] Saxena S, Raja A. Natural Dyes: Sources, Chemistry, Application and Sustainability Issues. In: Murthu S edition. Roadmap to Sustainable Textiles and Clothing. Textile Science and Clothing Technology. 2014:37-80