IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

Coloration of Cotton Fabric with Banana Flower Extract

Neha Singh[1] and Archana Singh[2]

C.S.A. University of Agricultural and Technology, Kanpur

1 -Research Scholar 2. Assoc. Prof, Dept. of Textiles & Clothing, College of Community Science, C.S.A.U.A. &T., Kanpur

ABSTRACT

Along with consumer's awareness regarding eco-safety, there has been a tendency towards the use of environment friendly materials and textile dyeing with natural colorant is a global soaring interest for avoiding environment pollution incurred by synthetic dyes. Among all other sources banana is most promising for ample availability. After citrus, banana is the second biggest created natural product, contributing about 16% of the world's total fruit production. The review provides information about preparation of dye with banana petaloid using pseudostem sap, alum and tealeaves as mordants for Cotton. Dyeing parameters viz; concentration of dye material, extraction time, dyeing time and dyeing temperature with concentration of natural mordants and mordanting methods have been standardized.

Key words: Banana Petaloid Waste Exploitation, Eco-friendly Colouration, Natural Mordants, Colour Levelness and Colour Fastness

1. INTRODUCTON

Natural dyes, dyestuff and dyeing are as old as textiles themselves. Man has always been interested in colours; the art of dyeing has a long past and many of the dyes go back into prehistory. It was practised during the Bronze Age in Europe. The earliest written record of the use of natural dyes was found in China dated 2600 BC.

Today, dyeing is a complex and specialized science. Nearly all dyestuff is now produced from synthetic compounds. After invention of synthetic dyes, natural dyes are not used because of the advantage of synthetic dye over natural dye in respect of application, colour range, fastness properties, and availability. But, some synthetic dyes are hazardous, carcinogenic and also release vast amount of pollutant in the environment during their manufacturing.

The world is slowly realizing the damaging effects of several chemicals that are synthesized by men in laboratory. Ecology and pollution have therefore become a major concern to all. Green house effect, ozone layer depreciation, water pollution and improper waste disposal have become important issues. So, all developed countries are looking for safe environment. In this context, the textile industry, which uses hundreds of chemicals in production, from raw material to disposal, is generally regarded among the most polluting industry.

Recently, a number of commercial dyers and small textile export houses have started looking at the possibilities of using natural dyes for regular basis dyeing and printing of textiles to overcome environmental pollution caused by the synthetic dyes. This has led to the desire to turn to a traditional and more natural way of life with a belief that "All natural things are good for life on the earth". In this trend, there is now using natural colouring matters for textile substrates both natural and synthetic. The use of natural dyes cuts down significantly on the amount of

toxic effluent resulting from synthetic dye processes. Natural dyes have also been used for printing and dye-sensitized solar cells. Alongside their aesthetic qualities, natural dyes may offer other benefits, being antibacterial, deodorizing, and UV protective. The use of natural dyes in textile applications is growing rapidly, reflecting the strict environmental standards being established in many countries, and the concern about the health hazards associated with synthetic dyes.

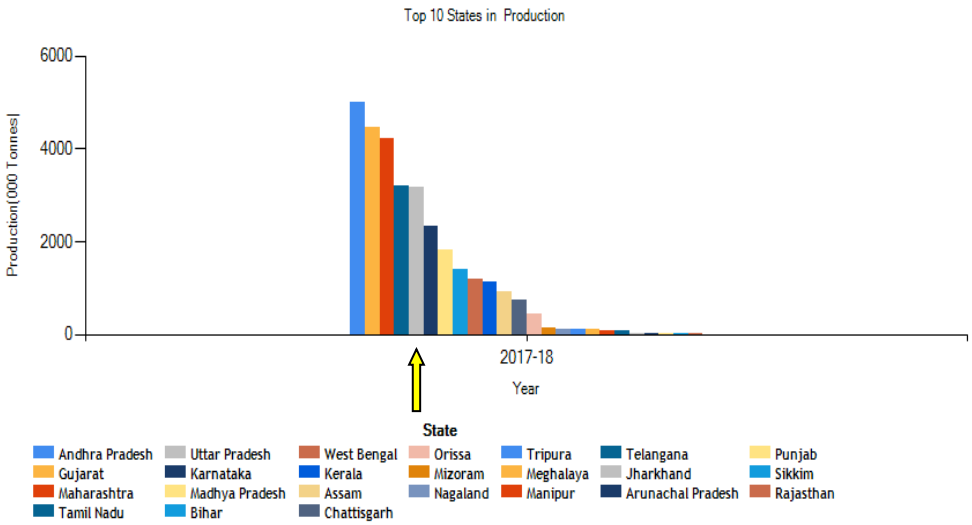


Fig:1- *{Source: National Horticulture Board (NHB)}*

Among all the state of India, Uttar Pradesh is not a large producer of banana but in last few years cultivation of banana has been increasing slowly. Out of top ten banana producing states U.P. is at fifth position in the year 2017-18 [Fig 1]. Acreage under banana cultivation is increasing rapidly in several districts viz., Basti, Bahraich, Shidharthnagar, Deoria, Gorakhpur, Koshambi, Fatehpur, Faizabad, Maharajganj, and Sitapur.

This present study attempts to extend the depth of shade and produce variety of colour on cotton fabric using Banana Flower Petals as natural dye together with various Environment friendly mordants. Effective exploitation of bio-resource waste of banana plant was also aim of this work.

2. MATERIAL AND METHODS

A series of experiments were conducted to determine optimum concentration of dye material, dye extraction time, dyeing time and dyeing temperature. These variables were optimized based on per cent absorption, λ-max of the solution must be known as well as percentage of marks obtained by panel of judges through visual evaluation of the dyed sample.

2.1 Raw materials and optimization

Fresh flowers of banana were collected from horticulture department, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. The petals of banana flower get separated and washed well and dried in oven at 180ºC for 40 min. The dried flowers were cut into small pieces [Fig 2]. For optimization of the dye concentration, 5, 10 and 15 g/ 100 ml of distilled water were taken.

2.2 Concentration of dye material

Dye solution were prepared separately by boiling of 5, 10, and 15 g of oven dry flower in 100 ml of selected extraction medium for 60 minutes at 80°C.

2.3 Dye extraction time

Oven dry banana flower was used as the raw material for dye extraction. Optimization of dye extraction was performed for different durations of 30, 45 and 60 min at 80ºC. The extracted dye was filtered and cooled at room temperature.

2.4 Dyeing time

Dye solution of oven dry banana flower with optimized concentration and extraction time was prepared. Cotton sample were dyed in the solution for 60, 90 and 120 min, respectively at 80ºC.

2.5 Dyeing temperature

Dyeing was done on different temperature of 60°C, 80°C and 100°C. Dyed samples were removed from the dye bath solution, rinsed in tap water, dried in shade and ironed.

2.6 Mordants and method of mordanting

Pre and post mordanting methods using 1, 3 and 5 g for alum and tea leaves both and 1, 3 and 5 ml for pseudostem sap were employed and mordanting was carried out for 30 min at 80ºC. In case of simultaneous mordanting and dyeing method, mordant was added during dyeing along with the dye in bath. The sample were removed from the dye bath, allowed to cool, rinsed under tap water, and squeezed lightly. These were dried in shade and ironed when half wet.

2.7 Colour strength measurement

The λ-max of the dye was determined through scanning in UV-VIS region. Absorbance was recorded after diluting the solution 10 times. The optical density (O.D.) of banana flower dye, was recorded at 470 nm wavelength.To calculate the percentage absorption, the absorption of the dye solution at λ-max was recorded both before and after dyeing by the following formulae

$$\textbf{Percent Absorption} = \frac{\textbf{O.D of the dye liquor before dyeing} - \textbf{O.D of the dye liquor after dyeing}}{\textbf{O.D. of the dye liquor before dyeing}} \times 100$$

To record the absorbance, the solution of the dye was diluted in the same way as it was diluted for recording of λ-max.

2.8 Visual evaluation

A Proforma was prepared for visual evaluation to judge the dyed samples for different aesthetic attributes viz; lusture, evenness of dye, depth of shade and overall appearance. A panel of 10 judges was selected through random sampling.

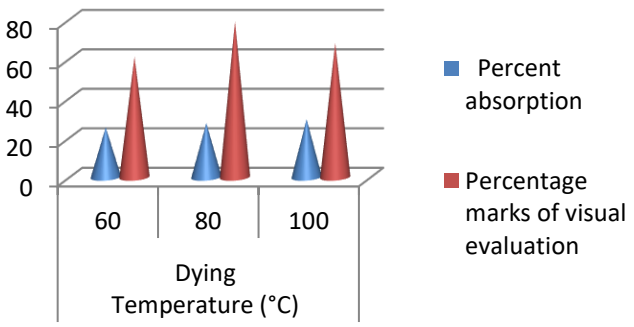


Fig. -3

2.9 Colour fastness properties

The light, washing, rubbing and perspiration fastnesses of the dyed samples were determined according to ISO 105-BO2:2002, IS: 3561:79, ISO: 9001:2008 and ISO-E04:2009 standards, respectively.

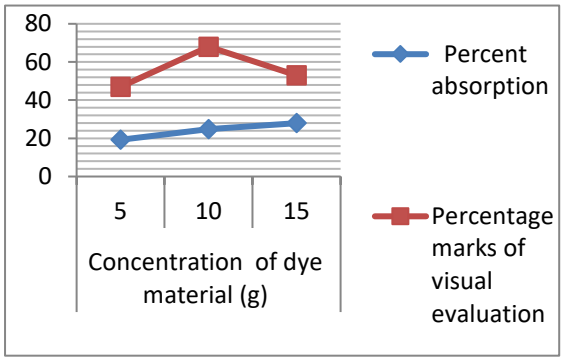


Fig. -4

3.RESULTS AND DISSCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads:

3.1Optimization of dye concentration

Cotton fabric was dyed with different concentrations of dye source (Fig 4.1). It is observed from the table that maximum percent absorption was obtained with 15 g, whereas sample dyed from 10 g, obtained the highest marks in visual evaluation.

So, on the basis of visual evaluation 10 g concentration was selected for dye instead of 15 g concentration (Fig. 3) because the visual evaluation was done on different criteria including lustre, evenness of dye, depth of shade and overall appearance of the colour which are considered as more important by consumers while selecting coloured textile materials. Since the percentage of marks obtained through visual evaluation is a subjective approach, the appearance of colour may or may not be influenced by maximum percentage of absorption.

3.2 Extraction time

Dye was extracted for 30, 45 and 60 min (Fig 4). It is evident from the figure that 60 min extraction time was found to be best. As reported by **Manimozhi and Kanakarajan (2017)**, sixty minutes extraction time was also considered as optimum for Acalypha Wilkesiana leaves dye used for cotton dyeing.

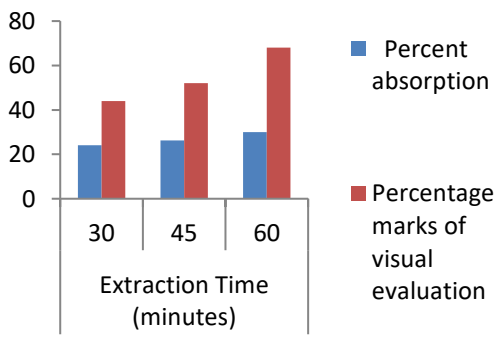


Fig.-5

3.3 Dyeing time

Cotton samples were dyed for 60, 90 and 120 minutes with Oven Dry Banana Flower. It was found that 120 min dyeing time given high absorption level (Table 1). The same sample obtained the highest marks as well after visual evaluation. Therefore, the best dyeing time selected was 120 minutes.

	Dying Time (minutes)		
	60	90	120
Percent absorption	29.01	33.9	40.17
Percentage marks of visual evaluation	49	65	81

Table -1

3.4 Dyeing temperature

Data represented in the table depicts the percentage of absorption of dye applied on different temperature from 60 to 100°C. On visual evaluation, it was found that the maximum marks were obtained by the sample dyed on 80°C, while 100°C temperature has highest percentage of absorption.

Therefore on the basis of visual evaluation 80°C temperature was selected for dye instead of 100°C temperature (Fig. 5) because visual evaluation might have more important factor for textile colouration as explained in 3.1.

The above result is similar to the optimized dyeing temperature 80°C of Curcumin Dye for dyeing of cotton by **Hasan et.al. (2014).**

3.5 Mordant concentration and mordanting methods

Different concentrations of mordants (1, 3 and 5g/100 ml of water for alum, tea leaves and 1, 3 and 5 ml/100 ml of water for banana pseudostem sap) were used with different mordanting methods. The percentage of marks obtained by samples mordanted with different concentration and various methods is given in table 4.

Table 2 Results for optimization of medium concentration and different mordanting methods

Mordant	Concentration of medium		Method of mordanting	
	Variables	Percentage marks of visual evaluation	Method	Percentage marks of visual evaluation
Alum (g)	1	75*	Pre	89*
	3	45.5	Sim	81.5
	5	42	Post	62.5
Tea leaves (g)	1	52	Pre	68
	3	67	Sim	87*
	5	69*	Post	66.5
Pseudostem sap (ml)	1	52	Pre	52
	3	67*	Sim	74*
	5	43	Post	47

Pre: pre-mordanting; Sim: simultaneous mordanting and dyeing and post: post mordanting
*Selected concentration and mordanting method

So on the basis of visual evaluation, 1 g concentration for alum, 5 g concentration of tea leaves and 3 ml for pseudostem sap gave best colour on cotton fabric simultaneously in case of mordanting methods simultaneous mordanting was found best with tea leaves and pseudostem sap on cotton fabric while in case of alum pre mordanting gave best result.

When the cotton samples dyed with oven dry banana flower dye, a range of tints and shades of various colours was produced.

3.6 Colour obtained on Cotton

Table -3 : Results of colours obtained by using various mordants and mordanting methods

Dye source	Mordants	Methods of Mordanting	Shades of colour
Oven Dry Flower of Banana	Alum	I	Beach pea 2620
		II	Worn white 2953
		III	Worn white 2953
	Tea leaves	I	Prime lime 2634
		II	Mustard 2698
		III	Mustard 2698
	Pseudostem sap	I	Light leaf brown 4214
		II	Light leaf brown 4214
		III	Light leaf brown 4214
Blank			**Light magenta**

Various colours were obtained on cotton when it was dyed. The colours obtained on cotton with different mordant and mordanting methods are shown in table 4.

Blank samples of cotton dyed with oven dry banana flowers reveals light magenta colour and after mordanting alum (method I) produced beach pea shade, (method II and III) produced Worn white with cotton samples.

In case of tea leaves (method II and III) gave mustard shade whereas (method I) gave prime lime shade. On the other hand light leaf brown colour was obtained by pseudostem sap in all methods of mordanting.

It was concluded that the use of alum and tea leaves with different mordanting methods developed very different colour on cotton samples whereas not much variation in colours were obtained by using different method of mordanting for banana sap.

The colour fastness properties of all the dyed samples were found to be satisfactory. The fastness properties of cotton fabric dyed with the flower extract are presented in table 3.

Table -4: Fastness properties of dyed samples

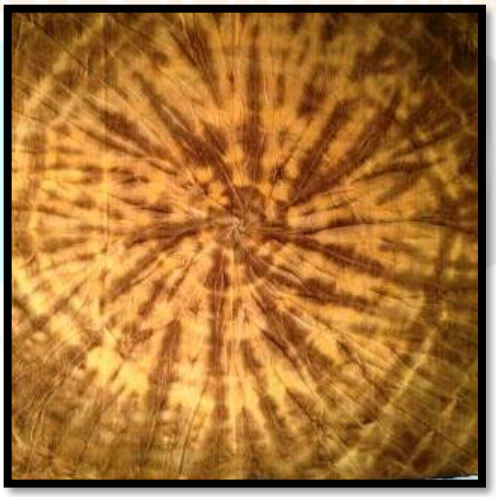
S. No.	Mordant	Method	Light fastness	Wash fastness		Perspiration fastness				Rubbing fastness			
						Acidic		Alkali		Dry		Wet	
				CC	CS	CC	CS	CC	CS	CC	CS	CC	CS
	Control		**3**	**4**	**4-5**	**3**	**4**	**4**	**5**	**5**	**5**	**4-5**	**4-5**
1	Tea leaves	Pre	3	4	4	5	4-5	5	4-5	5	5	5	4-5
		Sim	3-4	4	4-5	4-5	4-5	4-5	4-5	5	5	4-5	4-5
		Post	3-4	4	4-5	5	5	4-5	5	4-5	4-5	5	4-5
2	Alum	Pre	3	4	4	4-5	4-5	5	5	5	5	5	5
		Sim	3	4	4-5	4-5	4-5	5	4-5	5	5	5	4-5
		Post	3-4	4	4-5	5	5	5	5	5	5	5	5
3	Pseudo stem sap	Pre	3-4	4	4	5	4-5	4	4-5	5	5	5	4-5
		Sim	3-4	4	4	4-5	4-5	4-5	4-5	5	5	5	4-5
		Post	4	4-5	4	5	4-5	5	4-5	5	5	5	4-5

Pre: pre-mordanting; Sim: simultaneous mordanting and dyeing and post: post mordanting. CC: colour change and CS: colour staining

4. PREPARATION OF TEXTILE ARTICLE

Articles were dyed with banana flower dye by using standardized recipe as follows.

Name of articles	Dye used	Mordant used	Fabric	Method of mordanting	Technique used
Skirt	Oven dry flower	Tea leaves	Cotton	Simultaneous mordanting and dyeing method	Tie and dye (mango design)
Scarf	Oven dry flower	No Mordant	Cotton	Simultaneous mordanting and dyeing method	Tie and dye (circle effect)



5. COST CALCULATION

Cost of dyeing for 1 meter cotton fabric was calculated including the electricity charges, labour cost, chemical and mordants costs, as reported by **Devi et. al. 2013**.

Table -5: Cost calculation of Skirt with standardized dyeing process/ method

S. No.	Criteria of cost estimation	Cost/unit	Amount used	Value (Rs.)
1	Raw material (cotton)	90 Rs./m	½ meter	45
2	Dyes (oven dry banana flower)	-	25g	10.00
3	Mordant (tea leaves)	10 Rs./20g	5g	2.50
	Actual cost			**57.50/-**
Overhead charges which includes labour charge, cost of miscellaneous items, etc (20 per cent)				**69/-**

Table 4.6 Cost calculation of scarf with standardized dyeing method

S. No.	Criteria of cost estimation	Cost/unit	Amount used	Value (Rs.)
1	Raw material (cotton)	90 Rs./m	½ meter	45
2	Dyes (oven dry banana flower)	-	25g	10.00
	Actual cost	-	-	**55/-**
	Overhead charges which includes labour charge, cost of miscellaneous items, etc (20 per cent)			**66/-**

6. CONCLUSION

In this regards natural dyes are eco-friendly, safe, wonderful and rich in tones, act as health cure, have no disposal problems, non-carcinogenic, non-allergic, non-toxic, easily biodegradable and most important requires simple dye house to apply on matrix and mild reactions condition.

The extracts of banana flowers as a new source of natural dye showed astounding results on cotton fabrics.

The use of different mordants proved the effectiveness of the dye fixation as seen from the fastness results and also increased the colour palette of banana flower dye.

REFERNCES

Devi, A. I. and Srivastava, M. 2013. Traditional designs of Meitei community of Manipur: adaption on salwar kameez. *Asian journal of home science*. Vol.8 (1): pp 264-268.

Hasan, M. M.; Nayem, K. A. and Azim, M. A. 2014. Dyeing of Cotton and Silk Fabric with Purified Natural Curcumin Dye. *International Journal of Scientific Engineering and Technology*. Vol.3 (7): pp 838-844.

Manimozhi, R. and Kanakarajan, S. 2017. A Potential Dye From Acalypha Wilkesiana Muell Arg. For Conventional and Sonicator Dyeing of Cotton And Silk Yarn. *Research Journal of Pharmaceutical, Biological and Chemical Sciences*. Vol.8 (2): pp 2322-2334.