ICMIEE18-208

Dyeing of 100% Cotton Fabric using Natural Dye, Mordant and Natural Finish

A. K. M.Nayab-Ul-Hossain[1], Mohammad Naim Hassan[1], Aniruddha Sarkar[2] , S. M. Kamrul Hasan[2], Kaniz Fatima Mishfa[2]*
[1]Lecturer, Department of Textile Engineering, Khulna University of Engineering & Technology Khulna-9203, BANGLADESH
[2]Department of Textile Engineering, Khulna University of Engineering & Technology, Khulna-9203, BANGLADESH

ABSTRACT
Normally fabric is dyed with synthetic dyes, along with chemical fixing agent. In few cases fabric is dyed with natural dyes using synthetic mordant. Here this is clarified that 100% cotton fabric is dyed with natural dyes using natural mordant and at the same time applied natural finish (Neem, *Aloe vera* and Holy Basil (Tulsi) exudates). Ingredients which are applied, collected from surrounding environment that leads to a cost effective dyeing process. Moreover this is advantageous in easy application process as well as harmful free substances. Natural saps were collected from respective ingredients and at the same time the sample fabrics were conditioned for the purpose of easy penetration of dye molecules. Here as usual technique was applied for uniform and level dyeing and subsequently natural finishes were applied. The quality of the dyed fabric levelness is good. The fastness properties are also satisfactory. In comparison with chemical procedure, the applied dyeing process is easy to operate as well as less time consuming which meets all the necessary requirements of a perfect dyed fabric.

Keywords: Red Spinach, Betel Nut, Neem & Holy Basil (Tulsi) exudate, Anti-microbial finish, Natural ingredients.

1. Introduction:

The use of dye stuffs is as old as textiles themselves and pre-dates written history. Dyes are obtained from two main sources; the natural dyes and synthetic dyes.[1] Natural dyes can be defined as those organic materials that have the ability to impart color to any substrates which they must have had affinity for.[2] Until the mid-19th century, all dye stuffs were made from natural materials, mainly vegetable matters.[2] Research findings have reported that synthetic dyes are harmful to the body and thus the increased search into the arrays of plants for natural dyes which is more environmental friendly.[4] Natural dyes are biodegradable and very compatible with the environment.[5] These dyes can be obtained either from plants, animals, and minerals.[3]In this article work, no inorganic textile chemicals, auxiliaries & inorganic textile dyes were used & even the mordant is also natural as well as the natural finisher. Everything was collected from nature & our surrounded area and the full dyeing process was completed by using these natural items. The whole dyeing process is easier process and also have satisfactory result on color fastness test.

2. Material and fabric used:

2.1 This fabric was used for dyeing:

Composition : 100% Cotton
Construction : Single Jersey
Condition : Bleached

Natural ingredient: These natural ingredients Red Spinach, Henna, Sajina, Betel nut, Banana stem, and Tamarind leaf were used.
Aloe vera, Neem, Holy Basil (Tulsi) leaves were used for natural finishing.

2.2 Extraction of dye & finishing solution from natural ingredients:
(i) Firstly, the required ingredients were collected and cleaned properly by using water.
(ii) Ingredients were blended and turned into paste form.
(iii) These pastes were boiled at a certain temperature.
(iv) After boiling the exudates were filtrated.

3. Identification of sample and dyeing recipe:

We dyed sample by varying the recipe:

Sample 1:
Red spinach : 60%
Henna : 20%,
Sajina : 20%
Mordant : Betel nut
Finisher : *Aloe vera*

Sample 2:
Henna : 70%
Red spinach : 20%
Sajina : 10%
Mordant : Tamarind leaf solution
Finisher : Neem leaf

Sample 3:
Sajina : 50%
Henna : 30%
Red spinach : 20%
Mordant : Banana bark sap
Finisher : Holy Basil (tulsi)

4. Fabric preparation:

100% cotton fabric(bleached) has been used. Prior to dyeing, the sample fabric has been washed properly to maintain the proper absorbency for dyeing.

* Corresponding author. Tel.: +8801768476997
E-mail addresses: Nayonbutex04@gmail.com

5. Procedure of dyeing:

We have selected three nozzles and input the collected saps of different colors in the nozzles as per materials. We kept the nozzles to run for 30 minutes at 60°C.After that we added the natural fixer and kept additional 30 minutes at 60°C for proper & adequate take up of dye by the fabric. Here the total dyeing time was approximately 3 hours.

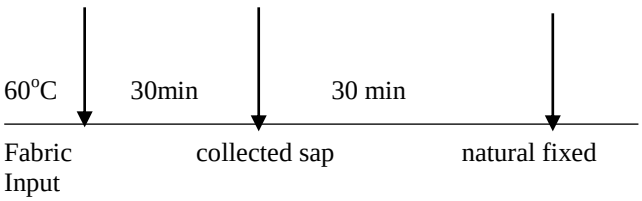


Fig: Dyeing Curve

5.1 Treatment after dyeing:

After dyeing the dyed fabric samples were washed properly to remove the unfixed surface color. We also used detergent to wash for good fastness result.

5.2 Finishing:

For finishing purpose, we used *Aloe vera* for sample 1, Neem paste for sample 2, Holy Basil (Tulsi) paste for sample 3. Firstly, the required ingredients were turn into paste form, then adequate amount of water have been added to turn the paste into juicy liquor so that the finishers can easily penetrate into the dyed fabric sample. The finishing treatment was continued for 1 hour at 60°C. After finishing treatment, the samples were rinsed with water for three times so that the surface particles (of the liquor) may be removed. Then the samples were allowed to dry.

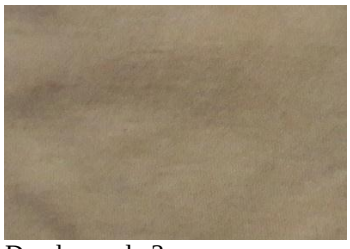
5.2 Color of dyed fabric:

Different tones of color was achieved by using different natural ingredients in different proportion. Various shades were found after dyeing the bleached fabric.

Bleached fabric which was dyed

Dyed sample 1:

Dyed sample 2:



Dyed sample 3

6. Different tests:

Different tests were carried out to check the fastness properties & dyeing accuracy. All the samples were tested in third party testing company A-ONE POLAR Limited which is a sister concern of Micro Fibre group. Test results of different tests are provided below.
Here different tests of dyed sample 2 are specially clarified with picture to illustrate testing procedure-

Test	Dyed Sample 01	Dyed Sample 02	Dyed Sample 03
Color fastness to wash	4	4	3-4
Color fastness to water	4	4	4
Color fastness to rubbing	3-4 both Wet & dry rub	4-5 both Wet & dry rub	3-4 both Wet & dry rub
Color fastness to perspiration	4	4-5	3-4

6.1 Color fastness to wash:(ISO-105-C06)

The color fastness to wash test was carried out by ISO-105-C06 method.
After carried out testing, multi fiber fabric illustrates that the result is **satisfactory.**
Color staining in dyed sample during this test is 4-5 & change in color is 4 which is in **acceptable range**.

Picture:1- Color fastness to wash

Acetate	Cotton	Polyamide	Polyester	Acrylic	Wool
4-5	4-5	4-5	4-5	4-5	4-5

Table:1- Color fastness to wash test result

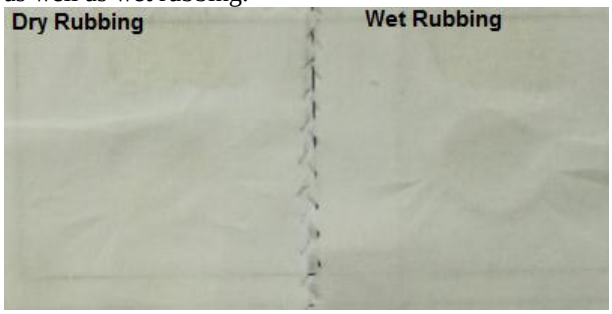
6.2 Color fastness to water: (ISO-105-E01)
The color fastness to water test was carried out by ISO-105-E01 method. Multi fiber fabric shows that the result is **good.** Change in color in this test is 4 which is **good.**

Picture:2- Color fastness to water

Acetate	Cotton	Polyamide	Polyester	Acrylic	Wool
4-5	4-5	4-5	4-5	4-5	4-5

Table:2- Color fastness to water test result

6.3 Color fastness to Rubbing: (ISO-105-X12)
The color fastness to rubbing test was carried out by ISO-105-X12 method & result is **good** both for the dry as well as wet rubbing.

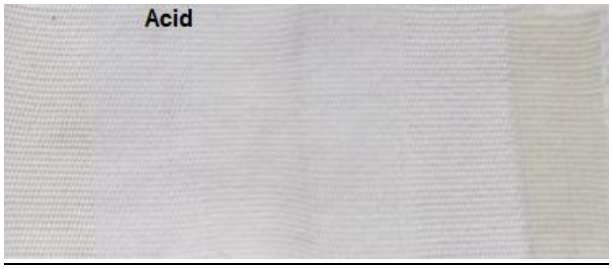


Picture:3- Color fastness to dry & wet rubbing

SL. no	Test name	rating
01.	Dry Rubbing	4-5
02.	Wet Rubbing	4-5

Table:3- Color fastness to rubbing test result

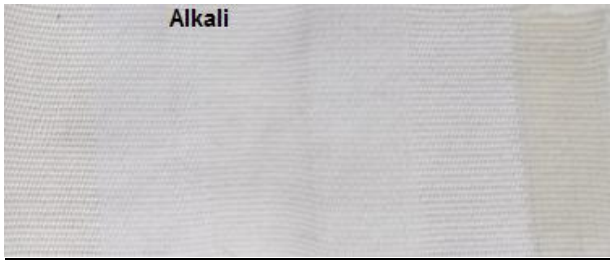
6.4 Color fastness Perspiration (ISO-105-E04):
The color fastness to perspiration test was carried out by ISO-105-E04 method. Both the acid & alkali tests were carried out. In every case the test result is **satisfactory** & change in color is 4 which is also **good**.



Picture:4- Color fastness to perspiration in acidic medium.

Acetate	Cotton	Polyamide	Polyester	Acrylic	Wool
4-5	4-5	4-5	4-5	4-5	4-5

Table:4- Color fastness to perspiration test result in acidic medium



Picture:5- Color fastness to perspiration in alkali medium.

Acetate	Cotton	Polyamide	Polyester	Acrylic	Wool
4-5	4-5	4-5	4-5	4-5	4-5

Table:5- Color fastness to perspiration test result in alkali medium

7 Dyeing quality:
We have come to know that the fastness properties are really **satisfactory**. The visual appearance of dyed samples is **good** as well as the physical appearance.
(i) No uneven shade was found in between the sample and within the sample.
(ii) Possibility of crease mark formation was more as the fabric was single jersey but actually nothing was happened.
(iii) All the dyed samples are free from any color spot.

8. Conclusion:
The result of this study has revealed that fully natural dyeing is possible without the use of inorganic mordant & the dyeing time is satisfactory. All the natural catalysts as well as the natural finishers were used for this dyeing suited perfectly with maintaining good dyeing quality & color fastness properties. In addition, the result of this experiment will add a bust to environmentally conscious consumers with growing need for organic clothing. This is just the step to dye naturally using fully natural ingredients but need more research to make this more convenient.

REFERENCE
[1] www.researchgate.net/publication/308035255
[2] Journal of Textile Engineering and Fashion Technology, volume 3, Issue3-201
[3] International journal of chemical studies 2017:5(6): 187-191
[4] Binitha kali, Gogai N. Cationic fixing agent. Indian Textile J. 1998;108(9-12):42–46
[5] Paul R, Jayes MV, Nayak SR. Natural dyes Classification, extraction and fastness properties. Textile Dyer & Printer. 1996;29(22):16–24