



OPTIMISING PROCESS OF NATURAL DYEING OF COTTON WITH ONION SKIN USING NATURAL MORDANTS

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Abstract:

Natural dyes have gained significant attention in textile dyeing due to their eco-friendly properties and aesthetic appeal. Onion skins, a readily available agricultural waste product, possess natural dyeing capabilities that can impart various shades of yellow and orange to textiles. However, achieving consistent and vibrant colors requires the use of mordants, which enhance dye absorption and colorfastness.

In this study, the focus is on optimizing dyeing variables when dyeing cotton with onion skin dye, employing natural mordants such as alum, lemon, harda (myrobalan), tamarind leaves, and Aloe vera. Mordants play a crucial role in dye fixation by forming complexes with the dye molecules, thereby improving color intensity and wash fastness of the dyed fabric.

The selection of natural mordants is based on their traditional use and effectiveness in enhancing dye uptake and color retention. Each mordant offers unique properties that can influence the final color and durability of the dyed cotton fabric. By systematically varying dyeing parameters such as mordant concentration, dyeing time, and temperature, this study aims to optimize the dyeing process to achieve desirable color outcomes while minimizing environmental impact.

Understanding and optimizing these variables not only contribute to the sustainable utilization of natural resources but also expand the repertoire of eco-friendly dyeing techniques in the textile industry. The results obtained from this research provide valuable insights into the practical application of onion skin dye with natural mordants, paving the way for enhanced utilization of natural dyes in textile production.

Index Terms – natural dye, mordant, sustainable, , optimization.

I. INTRODUCTION

Dye is an organic substance which imparts colour to the substrate which is fast to washing, light or other factors. Dyes are usually soluble in water. Even though dyes and pigments both impart or change colour of material they come in contact with, pigments are different from dyes, pigments can be organic or can be inorganic and are usually not soluble in any medium (Kumar, 2021).

The history of dyes is as ancient as any human civilization. Dyes are found in records of the Greco-Roman period. There are descriptions of natural dyes in Vedas and are also found on paintings of Ajanta, Ellora and Sithannaval and are still there showing efficiency of age-old dyeing craft of India. There are findings of a detailed process of natural dye making in the hieroglyphics of Ancient Egypt. From the time when primitive man started to create, they have been using natural dyes and pigments to colour their world. Natural dyes made from plants and animal sources were used by humans from ancient times until the mid of last century (History of Dye stuff, NPTEL).

Natural dyes are important non wood product from forest. They are used in food, cosmetics, textile, leather, medicine and stationary (Krizova, 2015)

In India, if needed all the textiles were dyed and printed with natural dyes and pigments till mid nineteenth century. Natural dyes were not especially used in India but it is a rich craft in ancient history. Dyes used for textiles were more than stains, people used dyes without any chemical processing. As development took place man started using dyes in systematic procedure, yet there is need of research done in this area (History of Dye stuff, NPTEL).

There are many plants from which yellow and brown dye can be extracted, brilliant colours were hard to extract and hence were more desirable. Tyrian purple is extracted from a species of Shellfish. Red dye is extracted from Kermes, Maddar and Cochineal. Yellow dye is extracted from Safflower and Saffron. Indigo colour is extracted from Indigo and Woad. Fustic is used to extract strong yellow dye, Logwood to extract purples and blacks, Cutch is used to extract brown dye, Weld for yellow, Lichens used to extract dyes from soft beiges, browns and pinks.

Different kinds of mordant are used to fix the dye to the textile material. Even though the mordant and dyes are insoluble in water they combine in fiber and make more or less insoluble chemical compounds. Alum, Chrome, Tin, Iron, Blue vitriol, Tannin and Cream of tartar are used as mordants and Glauber's salt is used as a levelling agent to even the dye (Brown, 1978).

Natural dyes can be used more than one time for colouring.

Dyeing textiles has been an age-old practice, evolving from natural sources to sophisticated methods. One intriguing avenue in contemporary textile dyeing is the use of onion skins, an abundant waste product often overlooked for its potential. This unconventional source presents a promising opportunity not only for sustainable dyeing practices but also for optimizing dye extraction and application processes. By harnessing the principles of onion skin optimization, researchers and artisans alike explore innovative techniques to enhance color intensity, fixation efficiency, and overall eco-friendliness in dyeing cotton fabrics where tradition meets cutting-edge technology, driving sustainable innovation in textile dyeing.

II. RESEARCH METHODOLOGY

Selection of substrate:

100% cotton was selected for the study as it is easily available. Cotton fabric is easy to handle so anyone in future can use the techniques used in the study for personal, educational or business purpose. Some technical and non-technical tests were done for the confirmation of purity of cotton. Solubility test with 70% H_2SO_4 and microscopic test for longitudinal appearance was done as technical test and for non-technical test, burning test was done.

Pretreatment of substrate:

The cotton fabric was scoured. It was soaked in warm water overnight which helped to remove the finishing chemicals applied to it. It helps dye to penetrate and dye evenly.

Selection of Natural dye and natural mordants:

Natural Dye onion skin was selected for present study. Four natural mordants were used in the present research work. Alum crushed into powder, Aloe Vera gel extracted from fresh leaves, lemon juice, fresh tamarind leaves and whole harda powder were the mordants used.



Plate - 1 Onion Skin, selected natural dye

Table 1 Selected natural mordants for the study

Sr. No.	Mordant name	Botanical name	Hindi name	Marathi name
1.	Crushed alum powder	Potassium aluminium sulphate	Fitkari	Turti
2.	Fresh aloe vera gel	<i>Aloe vera</i>	Ghrut Kumari	Korfad
3.	Lemon juice	<i>Citrus limon</i>	Nimbu	Limbu
4.	Fresh tamarind leaves	<i>Tamarindus indica</i>	Imli	Chincha
5.	Whole harda powder	<i>Terminalia chebula</i>	Harad	Hirda



Plate 2 Alum crystals powder



Plate 3 Leaves of Aloe Vera



Plate 4 Harda



Plate 5 Fresh lime



Plate 6 Tamarind leaves

Selection of Medium of dye extraction:

Onion skin was extracted in 100ml water and 10gm dye of each in acidic, neutral and basic (Sodium carbonate anhydrous/ Soda ash) mediums. For acidic medium few drops of Sulphuric acid was used. For basic medium a pinch of Sodium carbonate anhydrous was used. The medium which gave bright and dark colours was selected the basis of visual comparison.

Optimization of dye extraction time:

For dye extraction time 10gm of dye stuff was boiled with double boiling method in 200ml of water in basic medium for 15 min, 30 min, 45 min, 60 min, 75 min and 90 min each. The beakers were sealed for no water loss. Digital visible spectrophotometer was used to get the Optical density (OD) of the extractions and results were noted. Spectrophotometer was set on 800nm wavelength. For dyeing 6×6 inches' sample was dyed with double boiling method and beakers were sealed so that no amount of water evaporates. Then samples were dyed for half an hour each and OD of dye before and after dyeing were noted. Percentage of absorption was calculated. Time with highest percentage of absorption was selected as extraction time for all further processes.

$$\% \text{ of absorption} = \frac{\text{OD before dyeing} - \text{OD after dyeing}}{\text{OD before dyeing}} \times 100$$

Optimization of dye amount:

For dye amount 10gm, 15gm, 20gm, 25gm and 30gm each was extracted in 200 ml of water in basic medium separately. Dye was extracted for selected extraction time and samples were dyed for 30 min all with beakers sealed so that water does not evaporate. Optical density was noted and percentage of absorption was calculated and dye amount with highest percentage of absorption was selected as dye amount for all further processes.

Optimization of dyeing time:

For selection of dyeing time selected amount of dye stuff was extracted in 200 ml of water in basic medium for selected extraction time. Dyeing was done for 15 min, 30 min, 45 min, 60 min, 75 min and 90 min each. OD was noted before and after dyeing and percentage of absorption was calculated and time with highest percentage was selected for all further processes.

Optimization of mordant amount and mordanting methods for dyeing of cotton with Onion skins**Optimization of mordant amount:**

Simultaneous mordanting method was used for the optimization of mordant amount. Dye was extracted in standard conditions and simultaneous mordanting was done with 2 gm, 4 gm, 6gm, 8 gm, 10 gm and 12 gm amount of all five mordants. OD was calculated before and after dyeing. Percentage of absorption was calculated and amount of mordant with highest dye absorption was finalized.

Mordanting method:

For pre mordanting, mordant solution was prepared as per the optimized amount and samples were mordant for 30 min. After mordanting samples were dyed according to the optimized process. For post mordanting, samples were dyed according to the optimized process and mordanted in optimized amount of mordant solution for 30 min. OD was calculated before and after dyeing, and mordanting method was finalized.

RESULTS AND DISCUSSION**Confirmatory test of Cotton**

For solubility test small piece of cotton substrate for treated with 70% H_2SO_4 and cotton dissolved in it. In microscopic test longitudinal appearance was observed and fibers looked flat and twisted. For burning test a small piece of fabric was burnt to check the purity for 100% cotton poplin. It ignited quickly and burnt fast. It smelt like burnt paper and flaky grey ash was left behind. It all concluded that substrate was 100% pure cotton.

Medium of dye extraction:

Alkali medium was selected for extraction of dye from onion skin for cotton. Color obtained in basic medium was deepest and bright.



Alkaline

Neutral

Acidic

Plate 7 Onion skin dye on cotton using different medium of extraction**Dyeing of cotton with natural dyes.**

Red onion skins (*Allium cepa*) also known as 'Lal Kanda' in Marathi and 'Lal Pyaz' in Hindi in basic medium were selected

Optimization dyeing variables for dyeing of cotton with Onion skins**Optimization of dye extraction time:**

10 gm of onion skins each was extracted in 200 ml of water in basic medium and dye was extracted for 15 min, 30 min, 45 min, 60 min, 75 min and 90 min each. Samples were dyed in the extract for 30 min. Following are the results for the same.

Table 2 Percentage absorption of onion skins dye on cotton fabric at different extraction time

Sr. No.	Dye extraction time	OD before dyeing	OD after dyeing	% of absorption
1.	15 mins	0.830	0.545	34.25% **
2.	30 mins	0.925	0.904	2.27%
3.	45 mins	0.940	0.920	2.12%
4.	60 mins	0.945	0.940	0.52% *
5.	75 mins	0.941	0.918	2.44%
6.	90 mins	0.927	0.834	10.03%

(Note: *lowest percentage, ** highest percentage)

On the basis of results, the highest percentage of absorption was observed for 15 min of dye extraction for onion skins dye. So 15 min was optimized as dye extraction time for all further processes. Results shows that extraction for long time do not yield more dye, hence resources can be saved by extracting dye to the minimum time required.







Extraction time	Dyed sample	Pantone Shade no
Extraction of Onion skins dye for 15 min *		PANTONE 7521 C
Extraction of Onion skins dye for 30 min		PANTONE 7612 C
Extraction of Onion skins dye for 45 min		PANTONE 7613 C
Extraction of Onion skins dye for 60 min		PANTONE 7613 C
Extraction of Onion skins dye for 75 min		PANTONE 5005 C
Extraction of Onion skins dye for 90 min		PANTONE 466 C

Plate 8 Different extraction time effect on onion skin dyed cotton fabric

4.5 Optimization of dye amount:

10 gm, 15 gm, 20 gm, 25 gm and 30 gm of dye was extracted for optimized extraction time i.e. 15 min of annatto and onion skins each in 200 ml of water in basic medium. Samples were dyed for 30 min in the extract made by optimized process and results are tabulated as follows.

Table 3 Percentage absorption of onion skins dye on cotton fabric at different dye concentration

Sr. No.	Dye amount	OD before dyeing	OD after dyeing	% of absorption
1.	10 gm	0.688	0.677	1.59% **
2.	15 gm	0.699	0.697	0.28% *
3.	20 gm	0.777	0.771	0.77%
4.	25 gm	0.807	0.797	0.99%
5.	30gm	0.883	0.878	0.56%

Note:*lowest percentage, ** highest percentage)

On the basis of results, the highest percentage of absorption was for 10 gm for onion skins. The above tabulated results show that

more dye concentration does not help the substrate to absorb more, so minimum required amount should be used and raw material should be used without wasting.






Dye Amount	Dyed sample	Pantone Shade no
Extraction of 10 gm Onion skins dye for 15 min *		PANTONE 2316 C
Extraction of 15 gm Onion skins dye for 15 min		PANTONE 2312 C
Extraction of 20 gm Onion skins dye for 15 min		PANTONE 4725 C
Extraction of 25 gm Onion skins dye for 15 min		PANTONE 4725 C
Extraction of 30 gm Onion skins dye for 15 min		PANTONE 4725 C

Plate 9 Different dye concentration effect on onion skin dyed cotton fabric

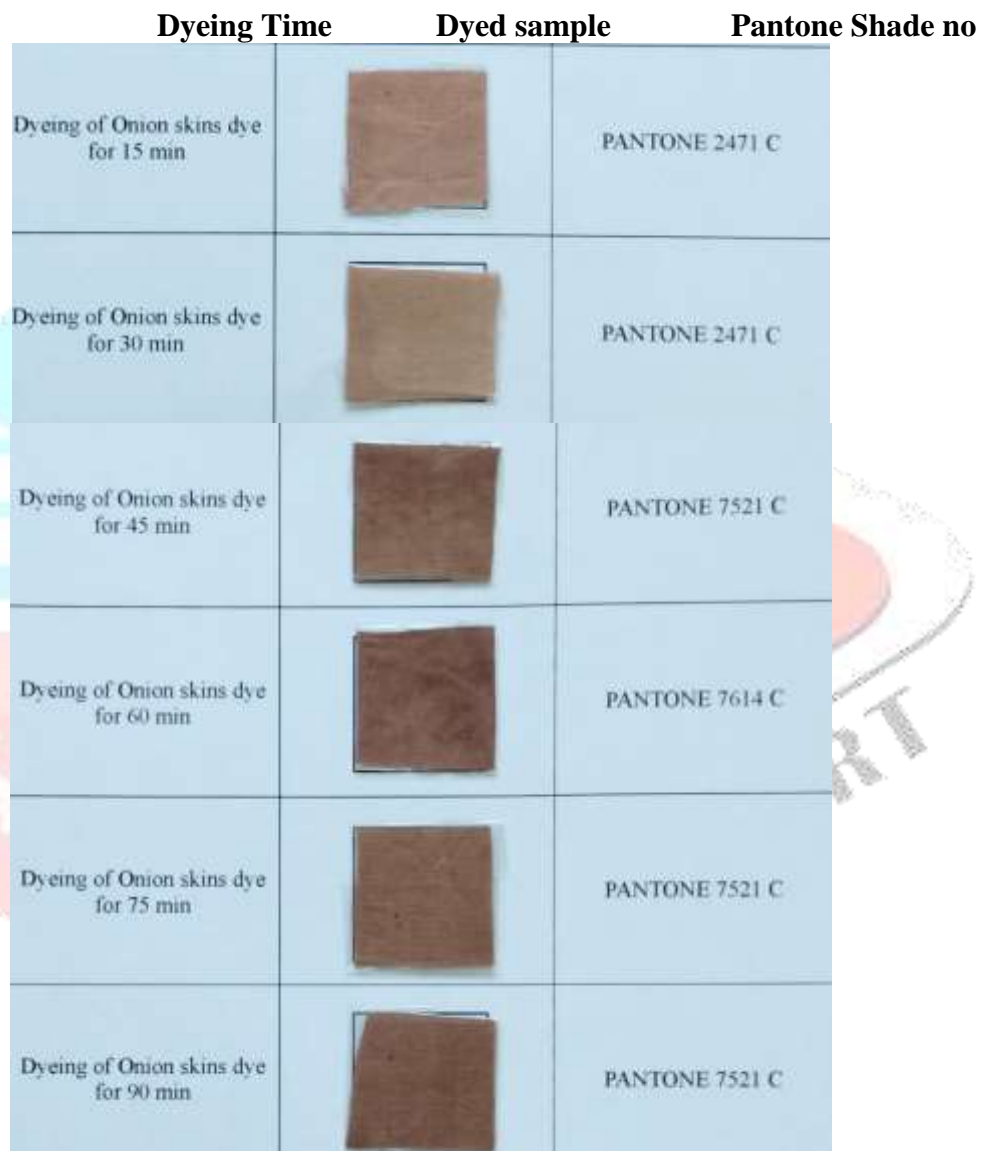
Optimization of dyeing time:

As per optimized process till 10 gm of onion skins were extracted for 15 mins each in 200 ml water in basic medium. Then samples were dyed by frequently increasing time from 15 min, 30 min, 45 min, 60 min, 75 min and 90 min and percentage of dye absorption was calculated. Following are the results for the same.

Table 4 Percentage absorption of onion skins dye on cotton fabric at different dyeing time

Sr. No.	Dyeing time	OD before dyeing	OD after dyeing	% of absorption
1.	15 mins	0.713	0.491	31.13%
2.	30 mins	0.836	0.515	38.39% **
3.	45 mins	0.561	0.547	2.49% *
4.	60 mins	0.674	0.544	19.28%
5.	75 mins	0.713	0.515	27.76%
6.	90 mins	0.753	0.595	20.98%

(Note: *lowest percentage, ** highest percentage)

**Plate 10 Different dyeing time effect on onion skin dyed cotton fabric****Optimized dye recipe to apply Onion skins dye on cotton**

Sample size – 6×6-inch pure cotton.
 Liquor – 200 ml water in basic medium.
 Dye extraction time – 15 min.
 Dye amount – 10 gm.
 Dyeing time – 30 min.

Optimization of Mordant amount for dyeing of cotton with Onion skins

For optimization of mordant amount simultaneous mordanting method was used. Optimized recipe of dyeing was used and with it 2 gm, 4gm, 6 gm, 8 gm, 10 gm and 12 gm of mordants for onion skins were used. Following are the results of percentage of absorption of the same.

Optimization of amount of Alum powder

Table 5 Percentage absorption of onion skins dye on cotton fabric with different concentration of Alum

Sr. No.	Mordant amount	OD before dyeing	OD after dyeing	% of absorption
1.	2 gm	0.792	0.466	41.16% **
2.	4 gm	0.792	0.570	28.03%
3.	6 gm	0.792	0.621	21.59%
4.	8 gm	0.792	0.629	20.58%
5.	10 gm	0.792	0.601	24.11%
6.	12 gm	0.792	0.667	15.78% *

(Note: *lowest percentage, ** highest percentage)

From the above results it is clear that 4 gm of alum (Potassium aluminium sulphate – $K_2(SO_4) \cdot Al_2(SO_4)_3 \cdot 24H_2O$) or also known as Aluminum hydroxide gel in medicine, 'Turti' in Marathi and 'Fitkari' in Hindi for onion skins was optimized. For onion skins alum acts as a magic mordant. Dye colour changes to shade of green from shade of mauve colour.







Alum amount	Dyed sample	Pantone Shade no
Mordanting of Onion skins dyed fabric with 2 gm Alum * (Simultaneous mordanting)		PANTONE 2279 C
Mordanting of Onion skins dyed fabric with 4 gm Alum (Simultaneous mordanting)		PANTONE 2279 C
Mordanting of Onion skins dyed fabric with 6 gm Alum (Simultaneous mordanting)		PANTONE 7491 C
Mordanting of Onion skins dyed fabric with 8 gm Alum (Simultaneous mordanting)		PANTONE 7491 C
Mordanting of Onion skins dyed fabric with 10 gm Alum (Simultaneous mordanting)		PANTONE 7491 C
Mordanting of Onion skins dyed fabric with 12 gm Alum (Simultaneous mordanting)		PANTONE 7491 C

Plate 11 Different Alum concentration effect on onion skin dyed cotton fabric

Optimization of amount of Aloe Vera gel:

From the below results it is concluded that 8gm Aloe Vera (*Aloe vera*) also known as 'Korfad' in Marathi and 'Ghrut Kumari' in Hindi is needed for optimized dyeing recipe of onion skins dye. Amount of Aloe Vera needed is quite high as compared to other mordants used in study. Aloe Vera as mordant makes the cotton fabric soft and smooth in feel. It also fades the shade a bit. Onion dye changes colour shade towards slightly brown.

Table 6 Percentage absorption of onion skins dye on cotton fabric with different concentration of Aloe Vera

Sr. No.	Mordant amount	OD before dyeing	OD after dyeing	% of absorption
1.	2 gm	0.789	0.767	2.78%
2.	4 gm	0.789	0.461	41.57%
3.	6 gm	0.789	0.563	28.77%
4.	8 gm	0.789	0.499	36.75% **
5.	10 gm	0.789	0.775	1.77% *
6.	12 gm	0.789	0.717	9.12%

(Note: *lowest percentage, ** highest percentage)







Aloe Vera amount	Dyed sample	Pantone Shade no
Mordanting of Onion skins dyed fabric with 6 gm Aloe Vera gel (Simultaneous mordanting)		PANTONE 2312 C
Mordanting of Onion skins dyed fabric with 8 gm Aloe Vera gel * (Simultaneous mordanting)		PANTONE 4525 C
Mordanting of Onion skins dyed fabric with 10 gm Aloe Vera gel (Simultaneous mordanting)		PANTONE 4525 C
Mordanting of Onion skins dyed fabric with 12 gm Aloe Vera gel (Simultaneous mordanting)		PANTONE 4525 C
Mordanting of Onion skins dyed fabric with 2 gm Aloe Vera gel (Simultaneous mordanting)		PANTONE 4525 C
Mordanting of Onion skins dyed fabric with 4 gm Aloe Vera gel (Simultaneous mordanting)		PANTONE 4525 C

Plate 12 Different Aloe Vera concentration effect on onion skin dyed cotton fabric**Optimization of amount of Lemon juice:****Table 7 Percentage absorption of onion skins dye on cotton fabric with different concentration of Lemon Juice**

Sr. No.	Mordant amount	OD before dyeing	OD after dyeing	% of absorption
1.	2 gm	0.739	0.481	34.91% **
2.	4 gm	0.739	0.401	33.55%
3.	6 gm	0.739	0.562	23.95%
4.	8 gm	0.739	0.626	15.29%
5.	10 gm	0.739	0.586	20.70%

6.	12 gm	0.739	0.709	4.05% *
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(Note: *lowest percentage, ** highest percentage)

From the above tabulated results, it shows that 2 gm of lemon juice is required for optimized dyeing recipe for onion skins. Lemon (*Citrus limon*) also known as 'Limbu' in Marathi and 'Nimbu' in Hindi as mordant gives a citrusy fresh fragrance to the fabric. For onion skins it works best. For onion skins dye colour shifts towards shade of pink.







Lemon amount	Dyed sample	Pantone Shade no
Mordanting of Onion skins dyed fabric with 2 gm Lemon juice * (Simultaneous mordanting)		PANTONE 7521 C
Mordanting of Onion skins dyed fabric with 4 gm Lemon juice (Simultaneous mordanting)		PANTONE 7613 C
Mordanting of Onion skins dyed fabric with 6 gm Lemon juice (Simultaneous mordanting)		PANTONE 7613 C
Mordanting of Onion skins dyed fabric with 8 gm Lemon juice (Simultaneous mordanting)		PANTONE 7613 C
Mordanting of Onion skins dyed fabric with 10 gm Lemon juice (Simultaneous mordanting)		PANTONE 7613 C
Mordanting of Onion skins dyed fabric with 12 gm Lemon juice (Simultaneous mordanting)		PANTONE 7613 C

Plate 13 Different Lemon concentration effect on onion skin dyed cotton fabric Optimization of amount of Tamarind leaves:

Table 8 Percentage of absorption of amount of Tamarind leaves in onion skins

Sr. No.	Mordant amount	OD before dyeing	OD after dyeing	% of absorption
1.	2 gm	0.837	0.637	23.89%
2.	4 gm	0.837	0.429	48.74% **
3.	6 gm	0.837	0.453	45.87%
4.	8 gm	0.837	0.669	20.07%
5.	10 gm	0.837	0.777	7.16% *
6.	12 gm	0.837	0.564	32.61%

(Note: *lowest percentage, ** highest percentage)

From the above results we get to know that 4 gm of Tamarind leaves (*Tamarindus indica*) also known as 'Chincha' in Marathi and 'Imli' in Hindi was optimised for onion skins dye as it gave best dye absorption. Tamarind leaves as mordant gives bright colour and colour shades do not change, remains like the optimized recipe dye colour shade. Tangy aroma is left in the substrate which is quite refreshing.







Tamarind leaves amount	Dyed sample	Pantone Shade no
Mordanting of Onion skins dyed fabric with 2 gm Tamarind leaves (Simultaneous mordanting)		PANTONE 7562 C
Mordanting of Onion skins dyed fabric with 4 gm Tamarind leaves* (Simultaneous mordanting)		PANTONE 2316 C
Mordanting of Onion skins dyed fabric with 6 gm Tamarind leaves (Simultaneous mordanting)		PANTONE 7562 C
Mordanting of Onion skins dyed fabric with 8 gm Tamarind leaves (Simultaneous mordanting)		PANTONE 2316 C
Mordanting of Onion skins dyed fabric with 10 gm Tamarind leaves (Simultaneous mordanting)		PANTONE 2316 C
Mordanting of Onion skins dyed fabric with 12 gm Tamarind leaves (Simultaneous mordanting)		PANTONE 2316 C

Plate 14 Different Tamarind leaves concentration effect on onion skin dyed cotton fabric

4.7.5 Optimization of amount of Harda powder:

Table 9 Percentage of absorption of amount of Harda in onion skins

Sr. No.	Mordant amount	OD before dyeing	OD after dyeing	% of absorption
1.	2 gm	0.771	0.471	38.91% **
2.	4 gm	0.771	0.543	29.57%
3.	6 gm	0.771	0.547	29.05%
4.	8 gm	0.771	0.601	22.04%
5.	10 gm	0.771	0.571	25.94%
6.	12 gm	0.771	0.625	18.93% *

(Note: *lowest percentage, ** highest percentage)

From the above tabulated results, we get to know that 2 gm of harda (*Terminalia chebula*) also known as 'Myrobalan' in English and 'Harad' in Hindi is optimized amount of mordant both for onion skins. Samples dyed in harda has slightly less colour shade than that of optimized dyeing sample. Samples also has some deposits of harda powder.







Harda amount	Dyed sample	Pantone Shade no
Mordanting of Onion skins dyed fabric with 2 gm Harda powder * (Simultaneous mordanting)		PANTONE 2311 C
Mordanting of Onion skins dyed fabric with 4 gm Harda powder (Simultaneous mordanting)		PANTONE 2311 C
Mordanting of Onion skins dyed fabric with 6 gm Harda powder (Simultaneous mordanting)		PANTONE 2311 C
Mordanting of Onion skins dyed fabric with 8 gm Harda powder (Simultaneous mordanting)		PANTONE 4665 C
Mordanting of Onion skins dyed fabric with 10 gm Harda powder (Simultaneous mordanting)		PANTONE 4665 C
Mordanting of Onion skins dyed fabric with 12 gm Harda powder (Simultaneous mordanting)		PANTONE 4665 C

Plate 15 Different Harda concentration effect on onion skin dyed cotton fabric

Comparative study of Mordanting methods

All the above mordanting samples were done by simultaneous mordanting. Next mordanting was done with all five selected mordants with pre mordanting and post mordanting. In pre mordanting samples were mordant in optimized amount of mordant and the dyed with the optimized recipe and OD of dye before dyeing and after dyeing were noted.

For post mordanting samples were dyed with optimized recipe and then mordanting was done in optimized mordant amount. OD of dye for post mordanting was not done as it gives result only for dyeing process and not for mordanting. Following are the results for pre mordanting

Table 10 Percentage of absorption of pre mordanting method for onion skins with different mordants

Sr. No.	Mordant amount	OD before dyeing	OD after dyeing	% of absorption
1.	Alum	0.792	0.316	60.10% **
2.	Aloe Vera	0.792	0.555	29.92%
3.	Lemon	0.792	0.754	4.79%
4.	Tamarind leaves	0.792	0.618	21.96%
5.	Harda	0.792	0.734	7.32 *

(Note: *lowest percentage, ** highest percentage)

In pre mordanting colour shades do not change for the onion skins dye. But in post mordanting onion skins shade turns pale yellow.






Mordant used	Dyed sample	Pantone Shade no
Pre mordanting of Onion skins dyed fabric with Harda powder		PANTONE 5875 C
Pre mordanting of Onion skins dyed fabric with Alum		PANTONE 584 C
Pre mordanting of Onion skins dyed fabric with Aloe Vera gel		PANTONE 5865 C
Pre mordanting of Onion skins dyed fabric with Lemon juice		PANTONE 5875 C
Pre mordanting of Onion skins dyed fabric with Tamarind leaves		PANTONE 5865 C

Plate 16 Effect of pre mordanting method of various mordants on onion skin dyed cotton fabric

Comparative study of pre and simultaneous mordant cotton samples dyed with onion skin using different mordants

Table 11 Comparison of pre and simultaneous mordant cotton samples dyed with onion skin using different mordants

Sr. No.	Mordant	Amount	% dye absorption Pre Mordanting	% dye absorption simultaneous Mordanting
1.	Alum	2%	60.10 %	41.16 %
2.	Aloe Vera	8%	29.92 %	36.75 %
3.	Lemon	2%	4.79 %	34.9 %
4.	Tamarind leaves	4%	21.96 %	48.74 %
5.	Harda	2%	7.32 %	38.91 %

It has been observed during the study that all mordants gave better results in simultaneous mordanting as compared to pre mordanting. Only Alum gave better results in pre mordanting

CONCLUSION

Study has shown that onion skin can be effectively used as a dye for cotton under optimized conditions. The use of natural mordants such as Alum, aloe vera, lemon juice, tamarind leaves, and harda powder has been found to enhance the range of colors achievable with onion skin, producing shades like pink, yellow, brown, and khaki. Importantly, the study concludes that these dyes show good fixation on cotton, making the process effective.

Overall, the approach is deemed sustainable, providing not only effective dyeing but also yielding beautiful and subtle shades of color. This suggests that using onion skin as a dye could be a viable eco-friendly option for textile dyeing.

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Mordant used	Dyed sample	Pantone Shade no
Post mordanting of Onion skins dyed fabric with Alum		PANTONE 5767 C
Post mordanting of Onion skins dyed fabric with Aloe Vera		PANTONE 467 C
Post mordanting of Onion skins dyed fabric with Lemon juice		PANTONE 466 C
Post mordanting of Onion skins dyed fabric with Tamarind leaves		PANTONE 466 C
Post mordanting of Onion skins dyed fabric with Harda powder		PANTONE 467 C

Plate 17 Effect of post mordanting method of various mordents on onion skin dyed cotton fabric