

Studies On Peracetic Acid Bleaching And Dyeing Of Jute With Turmeric

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Abstract: Due to the stringent environmental regulations, peracetic acid is now being considered as an alternative to conventional sodium hypochlorite bleaching. Jute fabric was bleached with peracetic acid at varying pH conditions viz pH 2, pH 6 and pH 7 and varying time of treatment viz 60, 90 and 120 minutes. These bleached samples were pre mordanted with alum and then dyed with turmeric. The samples were tested for different appearance indices viz. whiteness, yellowness and brightness. The surface morphology of bleached samples was examined using SEM. The effect of varying bleaching conditions on dyeing with natural dye was also evaluated. From various analysis it was found that pH 7 and 90 minutes peracetic acid bleaching treatment gave best result.

Key Words: Paracetic acid, bleaching, Jute, turmeric, analysis, treatment.

1. INTRODUCTION:

During the past decade, increasing environmental awareness, new global agreements and international governmental policies and regulations have been driving forces behind the renewed interest in the natural fibres and its processes which includes selection of chemicals, dyes and materials. The attractiveness of a plant-based fibre comes from its high strength, natural availability and environmental friendliness and jute falls under this category (1). As jute has its inherent yellowish colour, it is difficult to obtain proper shade while dyeing. Destruction of surface colour of jute by bleaching is expected to provide better colour effect. Jute can be dyed with various classes of dyes namely, direct, reactive, vat, azoic etc. It also exhibits strong affinity towards many non-cotton dyes like basic, 1:2 metal complex and mordant dyes. This affinity is due to the presence of non-cellulosic constituents in jute and its structural peculiarities (2).

The popularity of hypochlorite is because of its low cost and excellent bleaching power at room temperature. However, the formation of highly toxic chlorinated organic byproduct (AOX) during the conventional sodium hypochlorite bleaching has restricted its use over the last few years (3-4). On the other hand, peracetic acid is environmentally safe. The commercial peracetic acid is an equilibrium solution of hydrogen peroxide, acetic acid, peracetic acid and water (5).

The present work was aimed at investigating the effect of pH and treatment time of bleaching jute with peracetic acid on its dyeing behaviour using turmeric dye. The fabric was bleached with peracetic acid at varying treatment conditions and then dyed with turmeric dye. The effect of bleaching on whiteness, yellowness and tensile strength were examined whereas the effect of bleaching on colour development was assessed by K/S values. Effect of different bleaching conditions on micro structure was investigated using scanning electron microphotography.

2. MATERIALS AND METHODS:

2.1 Material:

2.1.1. Fabric:

100% raw jute fabric was kindly supplied by the Department of Jute and Fibre Technology, Kolkata.

TABLE 1 Specification of the fabric

Fabric	Weave	Ends/cms	Picks/cms	Weight per unit area (gms/sq.mt)
Jute	Plain	30	15	632.33

2.1.2 Dyes and Chemicals

Turmeric was used as a natural dye and alum as mordant for the study. Sodium carbonate and detergent were used for the scouring of jute fabric. Peracetic acid was prepared by reacting glacial acetic acid and hydrogen peroxide as reported elsewhere. (2) All the chemicals used for the study were LR grade.

2.2 Methods:

2.2.1 Scouring

The fabric was scoured using 2g/L soda ash and 2g/L detergent keeping material to liquor ratio 1:40 at boiling temperature for 30 minutes. The samples were then rinsed thoroughly in water to remove traces of soap and dried in shade. The scoured fabric was bleached with peracetic acid.

2.2.2 Bleaching with peracetic acid

The scoured fabric was bleached with in-house synthesized peracetic acid. For this treatment jute fabric sample was dipped into peracetic acid at room temperature for varying time and pH conditions. Three pH and three bleaching time were chosen which were pH 2, 6 and 7 and 60, 90 and 120 minutes respectively.

2.2.3 Extraction of Dyes

In order to extract the dye, 3% (wt/vol) of raw turmeric was immersed in water and was boiled for 30 minutes and the extract was filtered and stored in refrigerator and used for dyeing without further purification. The dye extract thus obtained was directly used for dyeing of the bleached sample.

2.2.4 Mordanting

The mordant used for the study was alum (10% owf). The fabric samples were treated in the aqueous solution of the mordant for 30 minutes keeping material to liquor ratio 1:40. After treatment samples were squeezed and taken for dyeing.

2.2.5 Dyeing

The dyebath was prepared with 10% turmeric dye. The concentration of the dye in the extracted liquor was estimated from the pre-calibrated concentration v/s absorbance graph of turmeric powder. The pre-mordanted samples were dyed using 10% turmeric dye at room temperature for 10 minutes maintaining material to liquor ratio 1:40. The temperature of the dyebath was then gradually increased to boil and the dyeing was continued for 1 hour. After dyeing, the samples were thoroughly rinsed and dried.

2.2.6 Testing of the bleached samples

2.2.6.1 Optical Indices:

The whiteness, yellowness and brightness indices of the bleached fabric samples were assessed using Spectrascan 5100 spectrometer, manufactured by Premier Colourscan. Three readings were recorded for each sample.

2.2.6.2 Tensile Strength:

The tensile strength of the scoured and bleached fabric samples were determined as per ASTM D5035 test method using Instron, Model 1121, 10 KN Testing Instrument.

2.2.6.3 SEM Analysis:

The surface morphology of the scoured and bleached fabric samples were assessed and recorded using scanning electron microphotography.

2.2.6.4 K/S measurement:

The effect of bleaching treatment on colour depth of dyed jute fabric was examined in terms of K/S using Spectra Scan 5100 spectrophotometer interfaced with computer colour matching system.

3. RESULTS AND DISCUSSION:

3.1 Effect of pH on whiteness for bleaching at different time intervals

The scoured jute fabric was subjected to peracetic acid bleaching. The time and pH were varied. The time was varied for 60, 90 and 120 minutes whereas the pH was varied to 2, 6 and 7. The effect of pH on the whiteness index at different time interval is shown in Table 1, 2 and 3. It is seen from Table 1 that whiteness increases with the increase in pH from 2 to 7 for the time interval of 60 minutes. The whiteness at pH 2 for 60 minutes treatment was very poor but improved as pH was raised. At lower pH level peracetic acid remains stable and starts working as pH goes towards neutral side.

TABLE 1: Effect of pH on whiteness index of bleached fabric for 60 minutes bleaching

pH	Whiteness Index (Hunter lab)
pH 2	9.21 (27.51)
pH 6	16.31 (31.71)
pH 7	18.24 (42.60)

Note: Values in the parenthesis indicate corresponding value for brightness

TABLE 2: Effect of pH on whiteness index of bleached fabric for 90 minutes bleaching

Note: Values in the parenthesis indicate corresponding value for brightness

pH	Whiteness Index (Hunter Lab)
pH 2	17.67 (21.45)
pH 6	19.65 (36.88)
pH 7	20.29 (43.54)

Table 2 shows the results of whiteness index for varying pH levels for 90 minutes treatment time. From the table it is seen that with the rise in pH level the whiteness was improved. There is an uniform improvement in whiteness while it goes from pH 2 to pH 7.

TABLE 3: Effect of pH on whiteness index of bleached fabric for 120 minutes bleaching

pH	Whiteness Index (Hunter Lab)
pH 2	19.25 (23.06)
pH 6	20.47 (29.82)
pH 7	21.35 (44.53)

Note: Values in the parenthesis indicate corresponding value for brightness

When bleaching time was doubled from 60 to 120 minutes the whiteness was only marginally improved for all the values of pH (Table 3). It shows that there was no reasonable benefit obtained for prolonged bleaching for 120 minutes. Thus 60 minutes bleaching was found to be sufficient.

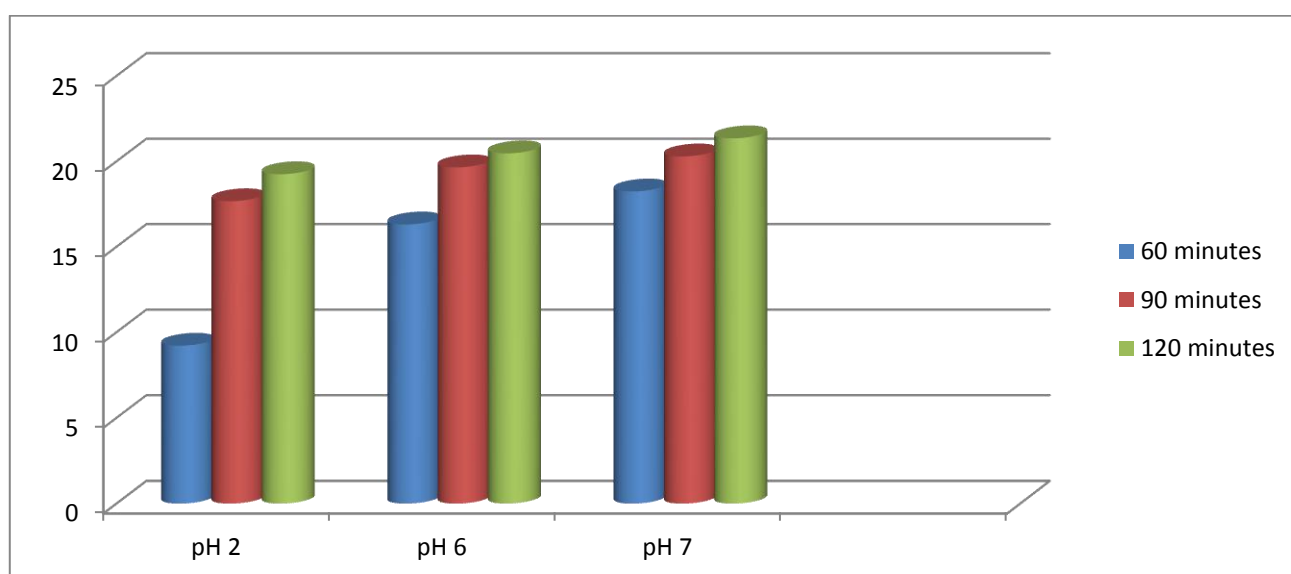


Figure 1: Effect of whiteness index on different time interval and pH

3.2 Effect of pH on the yellowness index at different time interval and pH

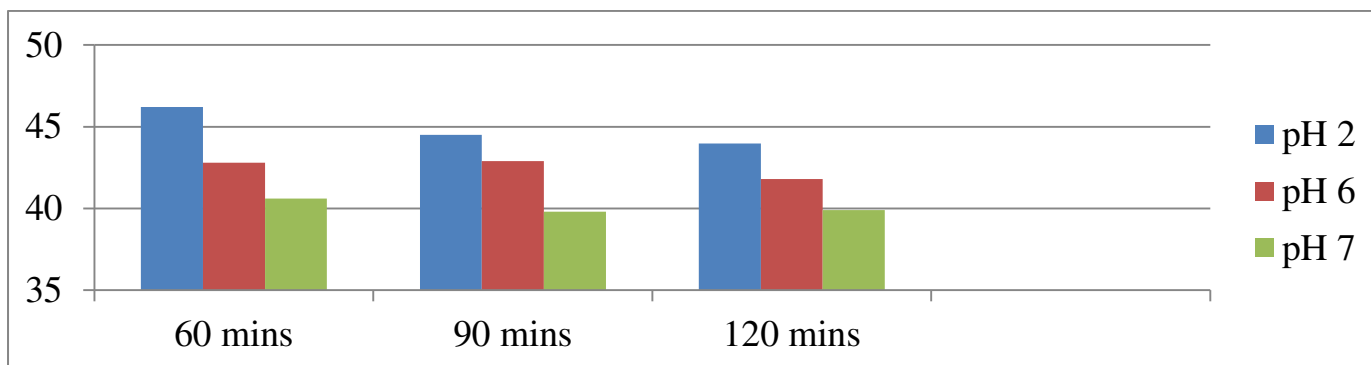


Figure 2: Effect of pH and time on Yellowness Index of the Bleached Sample

It is seen from figure 2 that the yellowness of jute fabric bleached with peracetic acid was reduced for rise in pH value and bleaching time. The reduction in yellowness indicates higher whiteness which supports the results of whiteness. The maximum yellowness was observed for 60 minutes bleaching whereas the lowest value was observed for 120 minutes bleaching.

3.3 Effect of different time intervals on tensile strength of bleached jute fabric

The peracetic acid bleaching at varying treatment conditions caused very little loss in tensile strength of jute as seen from Table 4. Since the treatment conditions were acidic to neutral it did not damage the fibre. So, peracetic acid bleaching can be a suitable alternative to alkaline bleaching of jute as the latter causes significant damage.

Table 4: Effect of treatment Time and pH on loss in Tensile Strength of jute fabric

Treatment	% Loss in tensile strength
Scoured	-
Treated for 60 minutes at pH 2	9.72
Treated for 90 minutes at pH 2	10.24
Treated for 120 minutes at pH 2	10.97
Treated for 60 minutes at pH 6	10.46
Treated for 90 minutes at pH 6	10.78
Treated for 120 minutes at pH 6	11.09
Treated for 60 minutes at pH 7	11.76
Treated for 90 minutes at pH 7	10.02
Treated for 120 minutes at pH 7	10.05

Figure 3 shows the scanning electron microphotographs of samples bleached at different pH for 90 minutes treatment time. The clarity of the jute fibre surface can be clearly noticed for bleaching at neutral conditions.

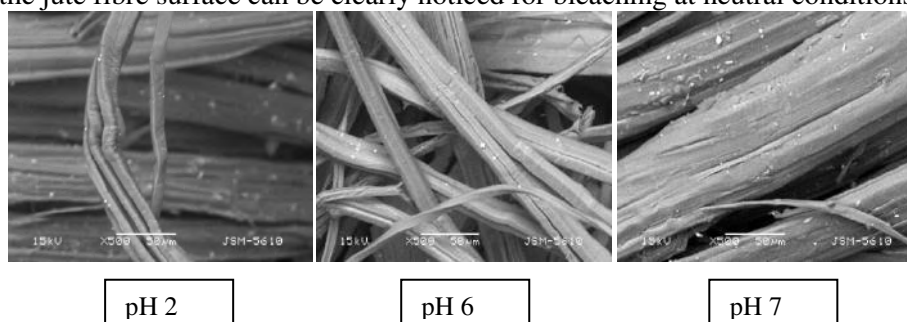


Figure 3: SEM images of treated jute fabric

3.4 Effect of different time interval on colour strength of turmeric dyed jute fabric

The bleached jute fabric sample were first premordanted as discussed in section 2.2.4 and dyed using 15% turmeric dye as described in section 2.2.5. From table 5 it is seen that as pH was increased from 2 to 7; the depth of the dyed samples were also increased for all the treatment conditions. The sample bleached at neutral pH manifested better colour depth since they had better whiteness and brightness indices. Though the colour depth of the samples bleached for 120 minutes were found to be maximum for all the pH values but found to be marginally improved compared with the colour depth obtained for 90 minutes treatment.

From all the results of peracetic acid bleaching and subsequent dyeing it may be concluded that pH 7 and bleaching time of 90 minutes may be ideal for jute fabric.

Table 5: Effect of time on the colour strength (K/S) values of turmeric dyed jute fabric

Time	K/S
Treated for 60 minutes at pH 2	22.0
Treated for 90 minutes at pH 2	23.6
Treated for 120 minutes at pH 2	23.8
Treated for 60 minutes at pH 6	23.5
Treated for 90 minutes at pH 6	25.8
Treated for 120 minutes at pH 6	26.7
Treated for 60 minutes at pH 7	25.6
Treated for 90 minutes at pH 7	26.9
Treated for 120 minutes at pH 7	27.1

4. CONCLUSIONS:

The scoured jute fabric was subjected to peracetic acid bleaching. The time and pH of bleaching treatment were varied. The time was varied for 60, 90 and 120 minutes whereas the pH was varied to 2, 6 and 7. The bleached jute fabric sample were first pre-mordanted as discussed in section 2.2.4 and dyed using 15% turmeric dye as described in section 2.2.5. The results revealed that

- The whiteness of jute fabric was improved steadily as pH was increased from 2 to 7.
- The improvement in whiteness and reduction of yellowness followed similar trend as pH was increased from 2 to 7 and time of treatment increased from 60 to 120 minutes.
- The peracetic acid bleaching at varying treatment conditions caused a little loss in tensile strength of jute. So, peracetic acid bleaching can be a suitable alternative to alkaline bleaching of jute which causes significant damage.
- From the results of peracetic acid bleaching and subsequent dyeing it may be concluded that pH 7 and bleaching time of 90 minutes may be ideal for jute fabric.

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