



A GREEN NANOTECHNOLOGY METHOD IN TEXTILE DYE PREPARATION USING COCONUT HUSK

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ABSTRACT

Color makes life more attractive and vibrant. Color is a universal substance so it is present everywhere as well as in every object like flowers, trees, sky, butterflies etc. Therefore in Textiles it is used as dye for coloring. There are two types of dyes used, they are Natural and synthetic. Natural colors are eco-friendly and biodegradable. In the present study the natural color was extracted from coconut coir fiber, where the cotton fabric was dipped in the extract supplying different thermal conditions. In the same way the coir extract was treated with Silver nitrate solution and kept in water bath for color change. The cotton fabric was dyed and tests like washing fastness, rubbing fastness, light fastness were performed. The mordants used before dyeing gave permanent and better color for the cloth. The Characterizations like UV Spectroscopy, Atomic force microscopic analysis, Fourier transform infrared spectroscopic analysis gave the evidence for the nanoparticle in the solution. For coconut coir extract UV spectral wavelength was 240 nm, and for silver nano particales with coconut coir extract was 380nm. According to the AFM test the size of the particle was 398.4 nm. The FTIR spectrum showed peaks indicating the stabilization molecules in the synthesis of Silver nitrate. Also by degumming the fabric before dyeing gave the more absorbance property for the fabric.

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INTRODUCTION

Indian Textile and natural dyes are considered as advanced and oldest. The mural paintings in the temples as well as ancient painting in the temples like Badami, Ihole, Ajanta-Ellora caves gives the evidence for permanent source of, dyes, where the people crushed the leaves, flowers and roots of the plants and extracted the juice from it, used for the paintings. There are many plants present which are natural sources of dyes and also they have medicinal values. By synthesizing these plant extract into nano particles may gives additional properties. Here we used coconut coir extract, where the phenolic group present in the coconut husk is responsible for the color.

The commonly used coconut is *Cocas nucifera*, which is widely available in coastal areas of Karnataka¹. Coconut is named for its versatility because all the part of coconut tree is useful since Coconut coir is considered as waste but using coconut coir solution we prepared dye².

In this study we synthesized the Silver nanoparticles by using Coconut husk extract. The nanoparticles contains antimicrobial, antifungal property which gives the additional values for the natural dyes. Natural dyes are eco-friendly and biodegradable. By using cotton fabric for dyeing gives the pollution free product. Now a days most of the people

interested towards the greenery and natural products so natural dye is one among the natural products. But disadvantage of natural dye is availability of sources. But coconut is such a source which is available in all the seasons. Moreover that it has medicinal value. The dye doesn't cause any irritation on skin like other synthetic dyes³. The nanotechnology is recently developing technology, because of the small size of the particles property also changes, like some conductors in macro state behave as insulator in nanostage also color varies in macro and nanostate because of the less fault in the shape of the atoms. These are more durable than the normal materials. Today there are vast Textile industries present all over the world. By using ancient Indian traditional methods of dyes with modern Nanotechnology we can also prepare the dyes which have advanced properties.

MATERIALS AND METHODOLOGY

Extraction of Natural dye from coconut coir (Sharan Madhu et al 2015)

Coconut husk fiber are collected from Alva's college cafeteria Moodbidri, Karnataka. Cut into small pieces and washed with distilled water two to three times, after that coir was dried in hot air oven at 50°C for a day. The 5g of coir was weighed and dissolved in 200ml of distilled water, It was boiled in water bath at 100°C for 3 hours and cooled at room temperature.

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Filtration of extract and size of the fabric (Ayesha aktar et al 2014)

The above solution was filtered by using filter paper and the solution was stored in conical flask. The 1m of white cotton fabric was washed thoroughly with detergent and dried. Then the fabric was cut into small pieces of size 5cm×10cm and it was further used for the study.

Degumming of a fabric (Ayesha akhtar et al 2014)

The fabric to be dyed was dipped in 3% of soap solution and heated to boiling for 1 hour about 50°C in order for degumming and fabric was washed two to three times with distilled water followed by drying.



Fig 1 Degummed fabric

Mordanting (Sharan Madhu et al 2015)

Mordant is a substance which set a dye on fabric, by performing a coordination complex with dye. Different mordants like Pomegranate rind, Lemon rind, Alum were used as a mordants.

The Pomegranate peel and Lemon peel was collected from Alvas college Juice center, Moodbidri, are dried and powdered. The alum which was collected from the Local market also powdered. About 2.5g of powder was dissolved in 250ml of distilled water separately and heated in a water bath at 60°C for 45 minutes, the solution was cooled and filtered. The pH of the solution was adjusted. Degummed fabric was treated with mordants and dried.



Fig 2: a) Alum b) Pomegranate Rind c) Lemon Rind

Synthesis of Silver nanoparticles (Gouthami Ramesh et al 2016)

Three millimolar silver nitrate was dissolved in 100ml of distilled water. To the 10 ml of silver nitrate solution 90ml of coir extract was added and boiled till the color change.

Dyeing of fabric (Radha Kashyap et al 2016)

50 ml of coir extract and coir extract with silver nitrate taken in different conical flasks. The mordanted Degummed white cotton cloth was dipped in extract separately and it was boiled at different temperature like 50°C, 75°C and 100°C respectively for two to three hours. The fabrics were removed from the solution and squeezed, dried. Color change in the fabric was observable. Again the cloths were dipped in

respective solutions for a day. Then fabric is squeezed and dried at hot air oven at 50°C.

Fastness properties

Wash fastness

The dyed sample was dipped in a 3% of soap solution for 20 minutes. Then it was washed with distilled water 8 times and squeezed, dried.

Light fastness

The dye sample were exposed to sunlight for 8 hrs a day for 10 days.

Rub fastness

The dyed sample was rubbed with white cotton fabric.



Fig 3 Test for washing fastness

Characterization of synthesized silver nanoparticles

The synthesized nanoparticles were characterized by UV-Visible spectroscopy. This is used to study the absorption peak of synthesized nanoparticles. The Fourier transform infrared spectroscopic analysis is used to study the functional group in the synthesized particles. And Atomic force microscopic analysis used to determine the size of the particles.

UV-Visible Spectroscopy

The change in the color was visually observable which indicates the presence of silver nanoparticles. The change in color is due to surface plasmon resonance. The absorption peak of the synthesized silver nanoparticle is 400 nm.

Fourier Transforms Infrared Spectroscopic Analysis (FTIR)

It was used to study the infrared absorption of particles. IR spectra were recorded using KBr pellet. On a Perkin-Elmer GX FTIR spectrometer.

Atomic force Microscopy (AFM)

Nanoparticles prepared by solution and the solution was casted on silicon wafers (|||) to make into thin films. These films are analyzed in no contact mode using pacific nanotechnology using Nano-R2 instrument.

RESULTS AND DISCUSSION

Extraction of Natural dye from coconut coir fiber and synthesis of Silver nanoparticles

The dye extracted from coconut coir was light reddish brown in color. The preparation of silver nitrate coir solution requires 2 hours to color change. The color of the solution become dark reddish brown. The dark coloured fabric were obtained from silver nitrate coir solution than the normal solution.



Fig 4 a) coconut coir Solution b) Coconut coir with Silver nitrate Solution

Identification of Phenolic Compound

Ferric Chloride test

1 ml of extract was mixed with 1 ml of Ethyl alcohol and 1 ml of 1N HCl is added, to that 1 drop of 3% Ferric chloride solution is added, deep red color pigments indicates the phenolic compound in the juice.



Fig 4 Ferric chloride test

Mordanting

The article (Sharn Madhu *et al* 2015) had that resultant cloths of different shades like Brown, Yellow and Pink by variation of pH. but in the present study resultant cloths had brown and pink colors under different conditions.

Table 1 The color of the mordents with different pH condition

Mordant's	Acidic pH	Neutral pH	Alkaline pH
Pomegranate rind	Light yellowish brown	Light yellowish brown	Yellowish brown
Lemon rind	Light yellow	Light yellow	Yellow
Alum	Colorless	Colorless	Turbid white

Fastness Property

The Fastness tests like washing fastness, rubbing fastness and light fastness tests conducted, by observing visually there was no color change in the fabric.

Characterization of Synthesized silver Nanoparticles UV Spectroscopy

The synthesized nanoparticles were characterized by UV-Visible spectroscopy. The absorption peak for coconut coir with silver nitrate solution is 400 nm and coconut coir solution is 280 nm

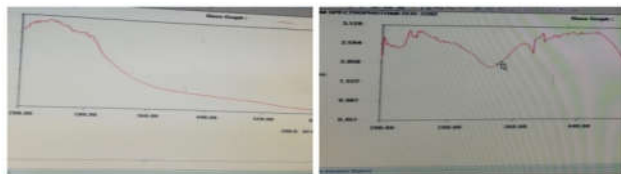


Fig 5 a) Coconut coir Solution b) Coconut coir silver nitrate solution

Atomic Force Microscopy and Fourier transform infrared spectroscopic analysis

The lyophilized silver nanoparticles sample were analyzed under FTIR to identify the functional group. The obtained spectra of nano particles range between 500-4000cm⁻¹. The absorption peak were observed, The band represents the stretch of C-H bond, H-C=O bond, C-C bond, C-O bond and C-H bond.

The AFM was used to observe the surface morphology and roughness. Figure 7. Showed that particles were n spherical in shape with size about 398.4nm, the size of the particle was much larger than the SEM because of magnification of preparation of sample for AFM.

The synthesized nanoparticles were analyzed in FTIR and AFM which gave the resultant graphs.

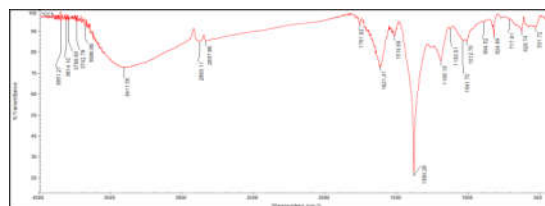


Fig6: Result of FTIR test

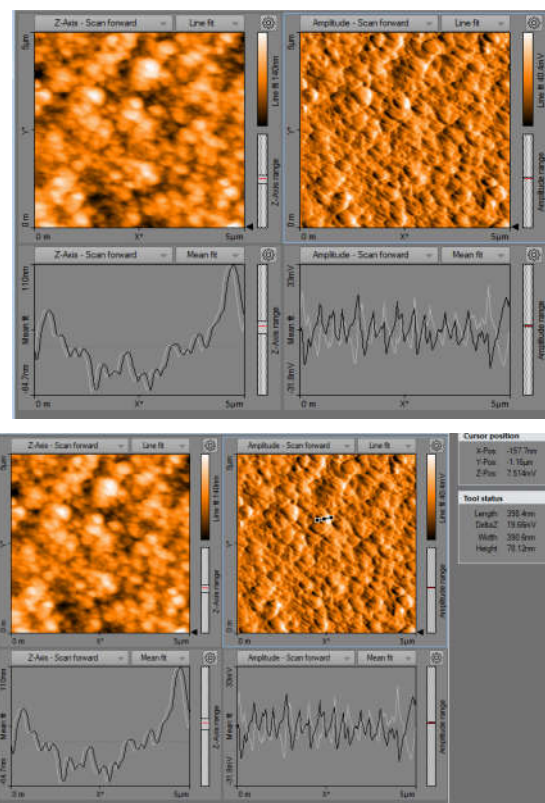


Fig 7: AFM test result
Remark – Size of the particle is 398.4 nm

CONCLUSION

Global awareness is very important in these days because the pollution increasing day by day beyond the margin, if we use natural product we can able to decrease the pollution. From the experiment we prepared the clothes of different shades like

pink, brown, yellowish brown etc. By using different mordents along with that positive antimicrobial property shows one step high towards the technological development, Along with this dye if we use other natural herbs then the dyeing effect is more effective. we prepared a antimicrobial dye which is permanent. Also applying advanced technology like nanotechnology we can able to develop the properties.

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