

Extraction of Tannin from Tamarind Seed Coat as a Natural Mordant for Dyeing of Wool Yarn

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Abstract: In this research, extraction of tannin as a natural mordant from tamarind seed coat. Tannin was extracted from tamarind seed coat using hot aqueous method. The qualitative analysis was carried out with various reagent and melting point determination for its purity were performed. The natural dye was extracted from rhizomes of turmeric by using aqueous method. The extracted tannin was employed as a natural mordant alone and in combination with metal mordant namely copper sulphate for wool yarn and dye using natural dyes. The visual colour strengths of all dyed wool yarns with and without mordant were compared. The pre-mordanted yarns on dyeing gave better color strength than the dyeing obtained without mordanting.

Keywords: Tannin, tamarind seed coat, wool yarn, mordant

I. INTRODUCTION

Tamarindus indica L., commonly known as tamarind tree, is one of the most important multipurpose tree species in the Indian sub-continent. The use of fruit pulp has been known for a very long time. Other uses are in food, chemicals and pharmaceuticals [1]. The seed consists of 30% hard but brown seed coat and 70% kernel. The seed extract is also reported to contain phenolic antioxidants and antimicrobial activity [2]. The seed coat containing 40% water soluble matter is nothing but a mixture of tannins. It is used for wound healing and as an anti-dysenteric drug.

Tannin is an astringent vegetable product found in a wide variety of plant parts such as bark, wood, fruit, fruit pods, leaves, roots and plant galls. Tannins are defined as naturally occurring water soluble polyphenolic compounds of high molecular weight (about 500–3000) containing phenolic hydroxyl groups to enable them to form effective cross links between proteins and other macromolecules [5].

Natural dyes were used only for coloring of textiles from ancient times till the nineteenth century. Colouring materials obtained from natural resources of plant, animal, mineral, and microbial origins were used for coloration of various textile materials. Recent environmental awareness has again revived interest in natural dyes mainly among environmentally conscious people. Natural dyes are considered eco-friendly as these are renewable and biodegradable; are skin friendly and may also provide health benefits to the wearer [7].

Curcuma longa Linn., commonly known as turmeric is one of the most important multipurpose species in South East Asia. Aqueous extract of its rhizome is used as natural dye for colouring in fabric and foods. Turmeric dye is one of the best known of natural dyes in our country. The aim of this study, tannin was extracted from tamarind seed coat and it was employed as a natural mordant alone and in combination with metal mordant namely copper (II) sulphate for dyeing of wool yarns using turmeric natural dye.

II. MATERIALS AND METHOD

Materials

Tamarind seeds and rhizome of turmeric were collected from Mandalay Township. Wool yarn was purchased from Amarapura Township, Mandalay. Commercial grade reagents were used for research work.

Method

Separation of Tamarind Seed Coat for Extraction of Tannin

The tamarind seeds were dried in a hot oven at 100°C for 30 min and the coat was removed from the seeds by manual crushing and separated. The brown-red husk was collected and ground into powder form.

Preliminary Phytochemical Screening

Preliminary phytochemical tests were carried out on tamarind seed coat powdered according to the reported methods [3].

Extraction of Tannin

The finely powdered tamarind seed coat (100 g) was extracted with water (200 mL) for 1 hr at boil and after cooling it was filtered through a fine muslin cloth and the filtrate was collected separately. The remaining residue was extracted three more times, in order to complete the extraction. The total extract (300 mL) was heated to boil and was allowed to stand overnight and filtered again. The clear filtrate was concentrated in a water bath and treated with saturated brine solution. A brownish coloured precipitate thus obtained was filtrated and dried in an oven to yield brown coloured tamarind seed coat tannin in powder form.

Qualitative Analysis for Tannin

The qualitative analysis was carried out by treating 0.5% solution of the above tannin product with various reagents such as gelatine, aqueous ferric chloride, lead acetate, copper sulphate solution, dilute hydrochloric acid solution and dilute sulphuric acid solution. The colour change after the addition of reagent was observed [4].

Determination of Melting Point

Gallenkamp melting point apparatus (England) was used for the measurement of melting point of tannin.

Extraction of Natural Dye

Dye solution was extracted from turmeric powder by using aqueous method. Distilled water only was used for extraction solvent. (10) g of the turmeric powder was boiled with 300 mL of distilled water about for 30 min. The content was cooled and filtered. The filtrate was used in dyeing process.



Figure 1. Turmeric Dye Solution

Bleaching of Wool Yarns

Firstly, wool yarn was washed in tap water with two drops of detergent to remove water soluble material. And then, it was soaked in cold water about 24 hours. It was washed with distilled water and wring out. Finally, it was used in pre-mordanting and dyeing process.



Figure 2. Bleaching of Wool Yarn

Mordanting

In this study, only pre-mordanting technique was used. Wool yarn was treated with 2 % tannin solution for 30 min. The tannin treated yarn was further treated with 1% of copper (II) sulphate solution at 70°C for 30 min. Wool yarn, only mordanted with tannin and in combination with mineral modrant, were squeezed and subjected to dyeing.

Dyeing Process

Wool yarns with and without pre-mordanting were introduced into the turmeric dye solution at room temperature and slowly the temperature was raised to 70°C. After that, the dyeing sample was left out from dye solution and dried in shade and good ventilation place. The dried dyeing sample was obtained.

III. RESULTS AND DISCUSSION

In this section, the result obtained from the experimental works such as phytochemical tests, qualitative analysis of tannin, melting point of tannin and dyeing process were discussed.

Preliminary Phytochemical Tests

Preliminary phytochemical tests were done to investigate the presence or absence of chemical constituents in tamarind seed coat. According to the phytochemical examinations alkaloids, steroids, flavonoids, polyphenol, saponins, reducing sugar, glycoside and tannins were found to be present in the sample. Among these compounds, tannins play an important role in dyeing process because it can be used as a natural mordant to sustain coloring matter permanently.

Qualitative Analysis of Tannin

The class of tannin obtained from tamarind seed coat, a set of qualitative experiments were carried out with various reagents and their results are given in Table 1. The result indicates that the tamarind seed coat extract gave identical colour and precipitation reaction when compared with the phlobatannins or condensed tannins as mentioned in the literature [6]. It produced a dark green precipitate with aqueous ferric chloride and dark red solids with dilute HCl solution. It clearly confirms that tamarind seed coat extract is condensed tannins.

Table (1) Qualitative Analysis of Tannins

Reagents	Observation
2% Gelatin	Dirty white precipitate
5% Aqueous ferric chloride	Dark green precipitate
10% Lead acetate	Pinkish precipitate
Copper (II) sulphate solution	Faint green
Dilute hydrochloric acid solution	Dark red solids
Dilute sulphuric acid solution	Flesh coloured precipitate



Figure 3. Characteristic Color Change of Tannin with Various Reagents

Melting Point Determination of Tannin

According to the literature, pure tannin can be obtained between the melting point range of 212-213 °C. In this study, the result of melting point obtained, (210-215°C) lies between the accessible ranges of melting point of pure tannin.

Table (2) Melting Point Determination of Tannin

Observed melting point	Literature value
210-215 °C	212-213 °C

Dyeing Process

The dyeing process includes three major steps; first begins the extraction of colouring matter from the rhizome of turmeric, second is mordanting the wool yarn and the last is actual dyeing. In this research work, pre-mordanting method was used and tannin was employed as the natural mordant which is no harmful effect on human skin. So the scored yarn was treated with 2% tannin solution at 70°C for 30 minutes. Moreover, tannin treated yarn was further treaded with 1% copper (II) sulphate solution at 70°C for 30 minutes. The wool yarns with and without mordanted were dyed with turmeric solution.

After dyeing, they were washed with cool water to remove unfixed dyes and dried in air at room temperature. Rinsing process was done by one time. There were found to have bright yellow colour for wool yarn without tannin, dark yellow for 2 % tannin and deep greenish yellow for 2 % tannin and 1% CuSO₄ solution and their results are shown in Table (3).

Table (3) Colour of Natural Dyes Wool Yarn with and without Mordanting

Natural dye	Mordants (%)	Colour obtained
Turmeric	without mordants	Pale yellow
	2 % Tannin	Dark yellow
	2 % Tannin + 1 % CuSO ₄	Deep greenish yellow

Comparative studies on Dyed Wool Yarns

without mordant



2% tannin

2% tannin and CuSO₄ solⁿ:**IV. CONCLUSION**

In this research work, the tamarind seed coat was selected for phytochemical analysis and extraction of tannin as a natural mordant for dyeing of wool with turmeric dye. From the experimental work, the extracted tannin was found to be suitable for a mordant in dyeing process. There were found to have bright yellow colour for wool yarn without tannin, dark yellow for 2 % tannin and deep greenish yellow for 2 % tannin and 1 % CuSO₄ solution.

The colour strengths of pre-mordanted wool yarns (2 % tannin only, and combination of 2 % tannin and 1 % CuSO₄ solution) are better than that of unmordanted wool yarn. The use of tannin as a natural mordant in dyeing process not only provides sustainable colour fastness properties but also give an eco-friendly products. This process is promising and should be easily industrialized, popularized among the local natural dyers.

REFERENCES

- [1] Dagar, J.C., Singh, G., Singh, N.T., Evolution of crops in agroforestry with teak (*Tectoma grandis*), maharukh (*Ailanthus excelsa*) and tamarind (*Tamarindus indica*) on reclaimed saltaffected soils. *Journal of Tropical Forest Science* 7 (4), 623–634, 1995.
- [2] De, M., De Krishna, A., Baneerjee, A.B., Antimicrobial screening of some Indian spices. *Phytotherapy Research* 13 (7), 616-618, 1995.
- [3] Harbourne, J.B., "Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis", 2nd ed., Chapman and Hall Ltd., U.S.A., 1984.
- [4] Prabhu, K.H., and Teli, M.D, "Eco-dyeing Using *Tamarindus indica* L. seed coat tannin as natural mordant for textiles with antibacterial activity", *Journal of Saudi Chemistry Society*, King Saud University, 2011.
- [5] Ramakrishnan, K., Selve, S.R., Shubha, R., Tannin and its analytical techniques, *Indian Chemical Engineering, Section A* 48 (2), 88-93, 2006.
- [6] Russell, A., The natural tannins. *Chemical Review* 17 (2), 155–186, 1935.
- [7] Sydjaroen, Y., Haubner, R., Wurtele, G., Hull, W.E., Erben, G., Spiegelhalder, B., Changbumrung, S., Bartsch, H., Owen, R.W., Isolation and structure elucidation of phenolic anti oxidants from tamarind (*Tamarindus indica*) seeds and pericarp. *Food and Chemical Technology* 43, 1673, 2005.