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Preparation, characterization and application of green coconut shell (*Cocos nucifera*) extract based azo dye

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Abstract: Environmental and toxicological concerns have resulted in increased interests in new diazotization reaction for the preparation of new azo compound. In this research work new azo dye has been prepared and aqueous extract of green coconut (*Cocos nucifera*) shell was used as a source of polyphnolic compounds. Green coconut grows abundantly in all over of Bangladesh and after taking the soft water the most of the coconut shell are discarded. Aqueous extract of green coconut shell was used to synthesize a new azo dye through diazotization reaction and the synthesized dye was characterized by FTIR and UV-VIS spectroscopy. Solubility of the dye was examined and found to soluble in organic solvents. The azo dye can be used as wood stain and along with shellac varnish gives an orange-red color to the wood coating.

Key words: Azo dye, *Cocos nucifera*, Polyphenols, coconut shell, Diazotization.

INTRODUCTION

Today researchers are searching for new colorants with increasingly enhanced properties for diverse applications as well as for more traditional uses. In addition, organic chemists are continuously trying to develop more efficient processes for the production of new dyestuff from natural sources which reduce

the environmental impact of the chemical and dyeing industry. Natural dyes are obtained from roots, leaves, barks, fruits and fruit-coat of the plants[1]. The structural features in organic compounds, that commonly produce color are >C=C<, –N=O, –N=N–, >C=O, $–NO_2$ and aromatic rings[2]. Azo compounds are a class of chemical compounds that bearing the functional group R−N=N−R′ and continuously receiving attention in scientific research [3-4]. The huge application and good tinctorial strength as well as stability make azo compounds important dyestuff. Azo dyes represent the largest group of disperse dyes in the textile industry[5-6]. Research effort should be devoted towards the development of a new dye and dyeing technique.

Azo compounds are formed by coupling an aromatic diazonium ion with an activated aromatic substrate. Aromatic diazonium ions are electrophilic reagents that can attack aromatic rings and replace the hydrogens at activated positions in the ring. The most active positions occur in rings that have either an amine or a hydroxy (phenol) substituent present. In the case of a phenol-type target molecule, the rate of attack is greatly increased if the phenol is first reacted with strong base to form a phenoxide ion.

Generally several kinds of wood and fruits are used as a phenolic source. In 2007 Sueli Rodrigues and Gustavo A.S.Pinto have estimated the phenolic content in coconut shell powder[7]. Green coconut (*cocos nucifera*) is a tropical fruit largely consumed in many countries. In some areas of the Brazilian coast, coconut shell represents more than 60% of the domestic waste volume. In Bangladesh it is known as 'Dab'and grows abundantly in all over the country, especially in coastal region. Its soft water is used as popular refreshing drinks which is also hygienic and nutritive. After taking the water green coconut shells are mainly discarded. The aqueous extract of green coconut shell also contains huge amount of polyphenolic compounds. The whole or every parts of this tree is claimed as a dyeware especially the husk enclosing the fruits[8]. Phenol constituents were obtained by the destructive distillation of coconut shells up to 280˚C[9]. A. Akhter *et al*. isolated polyphenolic compounds from the aqueous extract of green coconut shell and benzoyl ester derivatives were prepared with these polyphenols. Recently recovery of polyphenol compounds from coconut shell has been reported[11]. The objective of the present research work is to prepare an azo dye from green coconut shell extract which is also useful as a wood stain.

MATERIALS AND METHODS

***Collection of raw materials*:** Green coconut shells are collected from the local market of Rajshahi, Bangladesh. The green coconut shells were cleaned and juice was extracted by smashing and squeezing. About 900 mL of clear green coconut shell extract was boiled in a stainless steel beaker and concentrated to 300 mL.

***Diazotization reaction*:** 9.0mL of Anilne was taken in glass beaker and cooled in an ice bath. Similarly cooled 24.5 mL 30% HCl was added to the beaker in two installments. After the fume was subsided, previously cooled 20% solution of 6.75g $NaNO_2$ was slowly added to the beaker with continuous stirring. After few minutes diazonium salt was produced. When the nitrous fume was disappeared, 300 mL concentrated coconut shell juice was added slowly to the beaker which was then taken out of the ice bath. The highly acidic mixture was partially neutralized by dissolving 3.55 g NaOH in order to secure favorable condition for coupling reaction. The admixture was stirred thoroughly and allowed to stand for 24 hours. Finally the dye was separated by filtration.

***Fourier transform-infrared (FTIR) and UV-VIS spectroscopy*:** The FTIR absorption spectroscopy of synthesized azo dye was taken using the IR Prestige 21 Shimadzu Spectrometer. Dilute solution of the dye in ethanol was prepared and absorbance maximum was determined with Shimadzu UV-3600.

***Solubility and Application of azo dye*:** The prepared azo dye is soluble in methanol, ethanol, acetone and ethyl acetate and insoluble in water. The dye was found soluble in alkaline solution but insoluble in acidic medium. The azo dye was applied along with wood varnish. The wood varnish was prepared by dissolving shellac flakes and azo dye in methylated spirit.

RESULTS AND DISCUSSION

The prepared dye was found water insoluble although aqueous extract of green coconut was used for its preparation. This is an indication of the formation of disperse azo dye. The FTIR spectrum of the prepared azo dye is presented in **Figure 1**. In the FTIR spectrum absorption band at 1450 cm^{-1} is due to -N=N- stretching of mono azo compound. Azo colorants selectively reflect, transmit or scatter light in the visible spectrum and the absorbance maximum for the prepared dye was found at 420 nm **(Figure 2).** Due to water insolubility the dye cannot be applied directly on the fibers as textile dye but can be applied to hydrophobic fibers. The solubility in organic solvents also makes it suitable for application in the coloring of lacquers, plastics, printing inks and ball-point pen inks. Like disperse dye the hydrophobic nature of the synthesized azo dye might shows good wash fastness. The image of a wood sample coated by shellac varnish and the prepared azo dye is presented in **figure 3 (a)** and wood sample coated only with shellac varnish is presented in **figure 3 (b).** At very low concentration the dye imparts semi transparent orange-red color to the wood coating. The color of the wood sample is quite shiny and attractive than the wood coated with shellac varnish only.

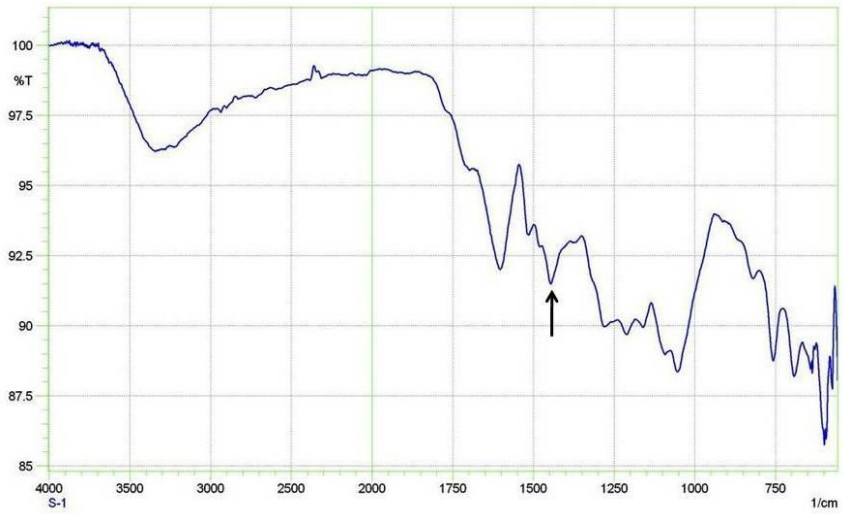

Figure 1: FTIR spectrum of coconut shell based azo dye

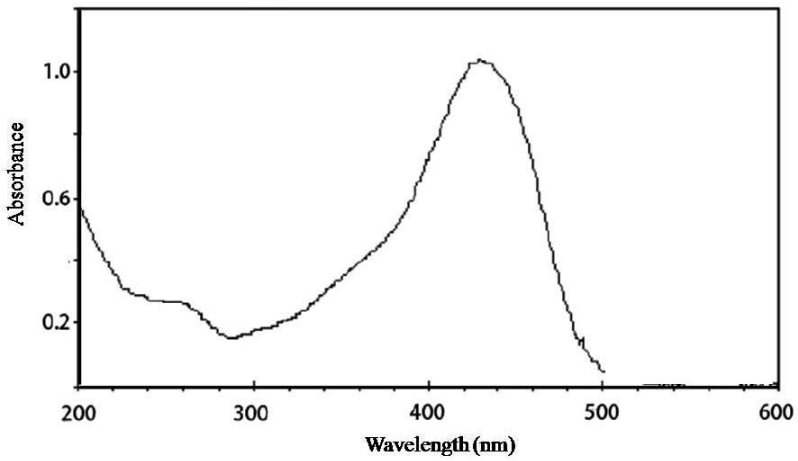

Figure 2: Absorption maxima (λ_{max}) of coconut shell based azo dye

(a) (b)

Figure 3: Wood coated with shellac varnish (a) with azo dye and (b) without dye

CONCLUSION

Azo dye was prepared from green coconut shell extract and characterized by FTIR and UV-VIS spectroscopy. The waste green coconut shell extract containing polyphenolic materials may be used to prepare azo dye. The utilization of waste coconut shell will be helpful for waste management as well as preparation of value added product from it.

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REFERENCES

1. A.F. Hill, Economic Botany, 2nd Edition, Mcgraw-hill publications in the botanical sciences, 1951.
2. Abrahart EN. Dyes and their intermediates, New York: Chem. Pub. Co., 1977.

3. Kirkan, B. and Gup, R., Synthesis of New Azo Dyes and Copper (II) Complexes Derived from Barbituric Acid and 4-Aminobenzoylhydrazone. *Turk. J. Chem.* 2008, 32, 9-17.
4. Seferoglu, Z., A study on tautomericequilibria of new hetarylazo-6-aminouracils, *ARKIVOC*, 8, 2009, 42-57.
5. H. M. Dardeer, El-sisi A. A., Emam A. A., Nora M. Hilal, Synthesis, Application of a Novel Azo Dye and Its Inclusion Complex with Beta-cyclodextrin onto Polyester Fabric, *Int. J. Text. Sci.* 2017, 6(3), 79-87.
6. Polya M. Miladinova, Reny K. Vaseva, Varbina R. Lukanova, Synthesis and investigation of some acid azo dyes for wool, *J. Chem. Technol. Metall.* 2015, 50(1), 20-25.
7. Sueli Rodrigues and Gustavo A.S.Pinto, Ultrasound extraction of phenolic compounds from coconut (*Cocos nucifera*) shell powder, *J. Food* Eng. 2007, 80 (3), 869-872.
8. George Watt, Dictionary of economic products of India, vol. 2, International Book Distributors, Dehardun, India, 1972.
9. Anonymous, The Wealth of India, A Dictionary of Indian Raw Materials and Industrial Products, Vol. 2, New Delhi: Publications and Information Directorate, 1950.
10. A. Akhter, S. Zaman, M. Umar Ali, M. Y. Ali and M. A. Jalil Miah, Isolation of Polyphenolic Compounds from the Green Coconut (*cocos nucifera*) Shell and Characterization of their Benzoyl Ester Derivatives, *J. Sci. Res.* 2010, 2(1), 186-190.
11. Recovery of polyphenols from agro food byproducts: Coconut shell and groundnut hull, Ajay, S., Madhan, S., Vadivel, V and Brindha, P., *Int. J. Pharm. Sci. Rev. Res.* 2016, 41(2), 161-167.

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