

FT-IR Analysis of *Terminalia Bellerica* and Their Antimicrobial Activity on Nonwoven Fabrics

Karpagam P^a, G. Manonmani^b

^a Assistant Professor, Department of Costume Design and Fashion, PSG College of Arts and Science, Tamilnadu, India

^b Research Supervisor, Department of Home Science, Mother Teresa Women's University, Coimbatore, India. Karpagam.psg@gmail.com

Abstract - The present study was carried out to characterize the bioactive constituents present in the herbal extract using FT-IR analysis. *Terminalia bellerica* was selected for the current investigation. The preliminary study was done with the extracts of *Terminalia bellerica* using well diffusion method against *E.coli* and *S.aureus*. The FT-IR analysis reported the presence of phenols, alcohols, amines and carboxylic acid. The quantitative assessment of the herbal extract coated fabric proved 85% of bacterial reduction. From this study it can be concluded that *T.bellerica* revealed antimicrobial activity against standard reference bacterial strains. Hence it can be exploited as natural drug for the treatment of various infections and it can be a substitute for wound dressing in medical textile.

Keywords: Bioactive compounds, Quantitative assay, FT-IR, Medical textile.

I. INTRODUCTION

Plants have been proved to be medicines from the ancient times. The medicinal plants are widely available throughout the world. Plants with active medicinal constituents are used to treat various diseases in the traditional systems like Ayurveda, Siddha and Unani. Nowadays, the use of medicinal plants are well established and well documented.

India is a varietal emporium of medicinal plants and is one of the richest sources of medicinal plants. It exhibits a wide range in topography and climate, which has a bearing on its vegetation and floristic composition. Moreover, the agroclimatic conditions are conducive for introducing and domesticating new exotic plant varieties. In India, the use of medicinal plants is centuries-old tradition and approximately two million traditional health practitioners still use medicinal plants for curing various ailments. Thus the current study aimed at the development of coated textile fabric with herbal extract.

II. MATERIALS

Tencel^R spunlace nonwoven fabric is the textile substrate used for the study having the weight of 45gm/cm² was purchased from Shanghai Guizhi International Co Ltd, China. The medicinal herb *Terminalia bellerica* were procured from the local market, Coimbatore, India. Solvents of chloroform, petroleum ether, ethanol and aqueous was supplied by Precision Scientific Chemicals, Coimbatore, India. Standard reference bacterial strains viz., pathogenic bacteria *Escherichia coli* and *Staphylococcus aureus* were obtained from KMCH, Coimbatore, India.

Plant Extraction

Both aqueous and alcoholic extraction was done. 5g of powdered plant material was dissolved in 25 ml of solvent in a conical flask and kept in a rotary shaker at room temperature for 48 hrs. The extracts were filtered through Whatman No 1 filter paper and the solvent was made to evaporate and mixed with DMSO (1ml/0.1 g). This was then stored in screw capped bottle for further study.

Screening of solvent and Preliminary Assessment of Antibacterial Activity

The Screening of best activity solvent out of four solvent extracts was evaluated by Well Diffusion method (Aida et al 2001).

Preliminary Assessment of Antibacterial Susceptibility Testing

The reference bacterial strains was inoculated for 1hr culture into nutrient broth and incubated for the growth at 37°C. After incubation a sterile cotton swab was immersed into the bacterial suspension and swabbed aseptically on the sterile Muller-Hinton agar plates. Wells of 6 mm diameter were punctured on the agar medium. About 60µl of the extracts was added to the wells. After which the plates were incubated at 37°C for 24 hrs in an incubator. Later on, the zone of inhibition was measured and recorded.

Application of Antibacterial finishing on nonwoven

Direct Application

The selected best activity herb in the solvent was finished on TencelR nonwoven fabric by dip-dry method. The

nonwoven fabric sample was made sterile with UV rays. Then the sterile fabric sample was finished with the selected plant extract by dip-dry method.

Quantitative Assessment (AATCC 100-2004)

The treated and untreated samples of circular swatches (4.8 × 0.1cm) were inoculated with the test organisms. After incubation, serial dilutions were made up to 10⁻⁷ for all the samples. About 0.1 ml of sample from each dilution were transferred to the sterile AATCC Bacteriostasis agar plates and spread plated. The incubated plates were examined for the presence of bacterial colonies. Figure 1 represents the

incubated flasks of treated and untreated fabric. The quantification of bacteria present in the media was determined and the percentage reduction by the treated specimen was calculated by the formula (2).

$$R = 100 (B - A) / B \quad \dots\dots\dots (2)$$

R = % reduction

A = the number of bacteria recovered from the inoculated treated swatch.

B = the number of bacteria recovered from the inoculated untreated swatch.

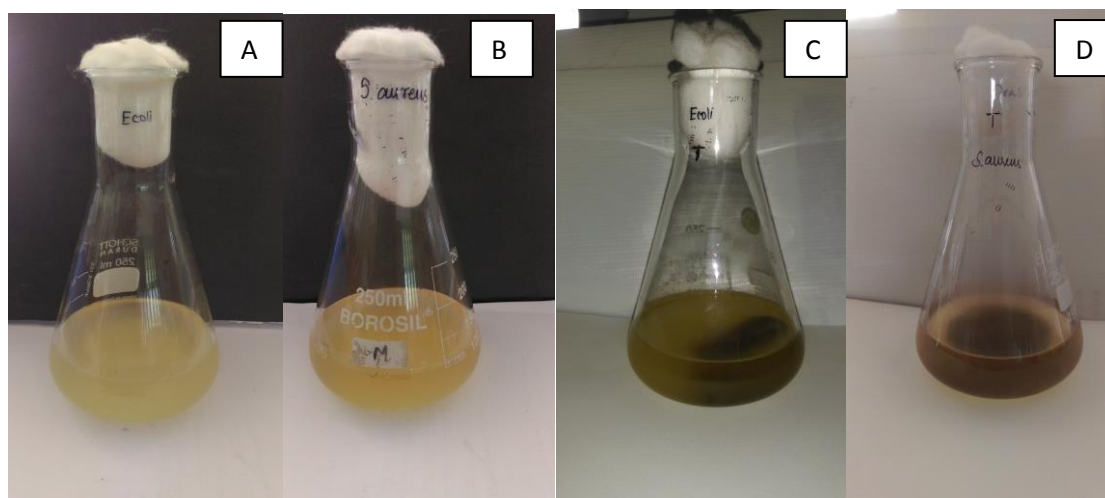


Figure 1: Quantitative Assessment (AATCC 100) of Treated and Untreated samples
 A: Untreated fabric sample against *E.coli*
 B: Untreated fabric sample against *S.aureus*
 C: Treated fabric sample against *E.coli*
 D: Treated fabric sample against *S.aureus*

III. RESULTS AND DISCUSSIONS

Preliminary Assessment of Antibacterial Susceptibility Testing (Well Diffusion method)

The selected plant extract was observed for the zone of inhibition. The results observed were interpreted in the figure 2 indicating the growth inhibition produced by *Terminalia bellerica* towards clinical bacterial pathogens. Aqueous extract of *Terminalia bellerica* showed significant activity with respect to petroleum ether and chloroform extracts. The chloroform extract of the *Terminalia bellerica* showed moderate zone of inhibition and petroleum ether exhibited less zone of inhibition against tested bacterial pathogens. Whereas poonkothai *et al* (2014) reported the similar results. The extracts exhibited significant results when compared with standard antibiotic (Tetracycline) and no zone of inhibition in case of DMSO. The Higher antibacterial activity of alcoholic extracts is the character of biological active compounds which may be enhanced in the presence of ethanol. They also have the stronger capacity to extract the compounds that may be active constituents of the antibacterial activity (Ghosh *et al*, 2008). Thus in the

present study similar results say that the ethanolic extracts of *Terminalia bellerica* showed good results among the other solvents.

Test organisms	<i>Terminalia bellerica</i>			
	Aqueous	Ethanol	Pet ether	Chloroform
<i>E.coli</i>	10	12	7	8
<i>S.aureus</i>	7	12	9	6

Figure 2: Preliminary Assessment of Antibacterial Susceptibility Testing

IV. CHEMICAL CHARACTERIZATION - FT-IR ANALYSIS

FTIR was adopted to characterize the potential interactions and to find the functional groups of the extract. FTIR spectra of herbal extract were analyzed and shown in figure 3. In the spectra of herbal ethanolic extract, the broad band at 3649.32, 3572.17 and 3495.01 cm⁻¹ corresponded to the

alcohols and phenols. The peaks at 2924.09, 2854.65 cm⁻¹ was caused by C-H stretch which showed the presence of alkanes. The C=C stretch indicated the presence of alkynes (2299.15 and 2206.57 cm⁻¹). The peaks at 1743.65 and 1721.79 cm⁻¹ corresponded to C=O stretch of carboxyl, esters and saturated aliphatic. The peak at 1527.62 represents the presence of nitro compounds with

asymmetric stretch, C-C stretch at 1458.18 confirms the occurrence of aromatic compounds. The peak at 1242.16 , 1165 , 1049.28 cm⁻¹ represented the C-N stretch which indicated the presence of aliphatic amines. =C-H bend states the presents of alkenes at 941 cm⁻¹. The peak at 802.39, 771.53 and 725.2 cm⁻¹ corresponds to C=C of aromatic compounds.

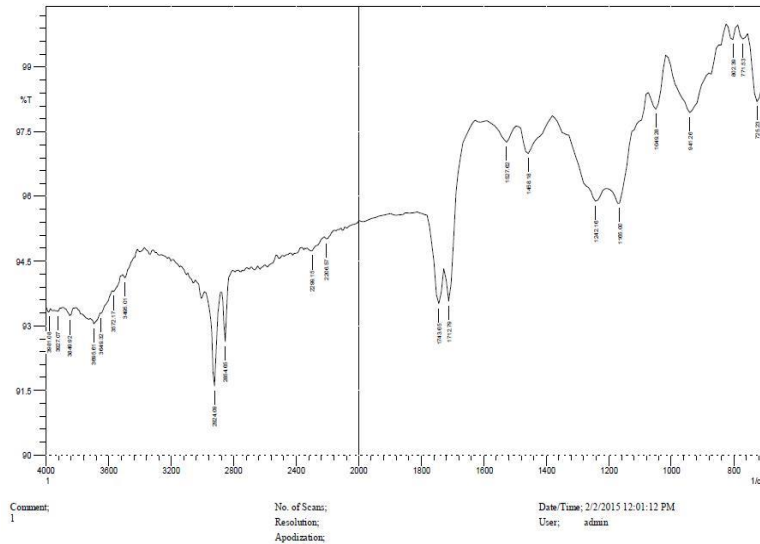


Fig 3: FT-IR analysis of Plant extract

Quantitative Assessment (AATCC 100-2004)

The treated sample was seemed to have clear broth solution after incubation which states that the treated fabric inhibits the test organism present in the broth solution. Whereas the organism was seemed to grow well in the incubated flask containing untreated fabric. The quantification of bacteria present in the media was found to have 85% of bacterial reduction.

V. CONCLUSION

Thus the study concludes that *Terminalia bellerica* possess broad spectrum of antibacterial activity and can be used as medicinal herb in medical non-implantables, healthcare and hygiene.

REFERENCES

[1] F. Scazzocchio, M.F Cometa, L. Tomassini, and M. Palmery, "Antibacterial Activity Of Hydrastis Canadensis Extract And It's Major Isolated Alkaloids", *Planta. Med*, 2001, 67, pp.561-563.

[2] G.Thilagavathi, R.Rathinamoorthy , "Optimisation Of Process Conditions Of Cotton Fabric Treatment With Terminalia Chebula Extract For Antibacterial Application", *IJFTR* , Vol 38, sep 2013, pp. 293-303

[3] T. Essawi, M. Srour, "Screening of some Palestinian medicinal plants for antibacterial activity" *J. Ethnopharmacol.*, 2000, 70, pp. 343-349

[4] M.Yoh, E. K. Frimpong, S. P. Voravuthikunchai, & T. Honda, "Effect of sub inhibitory concentrations of antimicrobial agents (quinolones and macrolide) on the production and release of Vero toxin by enterohaemorrhagic Escherichia coli" 1999 o157:H7. *Can. J. Microbial.* 45, pp. 732-739.

[5] K.M. Elizabeth, "Antimicrobial Activity Of Terminalia Bellerica, *Indian Journal of Clinical Biochemistry*, 2005, 20 (2) pp. 150-153

[6] WHO Traditional medicine: Growing needs and potential, WHO Policy perspectives on medicines. p. 1, World Health Organisation, Geneva 2002.

[7] M Jansen, J. J. C. Cheffer, A. B. Svendsen, *Planta Medica*, 1987, 40, pp. 395-398.

[8] J. Bruneton, *Pharmacognosy, Phytochemistry, Medicinal plants* 1995, pp. 265-380, France:Lavoisier Publishing Co.