



Development of poly herbal finished antibacterial wound dressing

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Abstract

The aim of the present study was to evaluate the antibacterial activity of the medicinal plants *Tridax procumbens*, *Coleus ambonicus*, *Aclypha indica*, *Vitex nigundo*, these plants possess various secondary metabolites which are responsible for its antiviral, anti-ulcer, anti-bacterial and anti-inflammatory properties. This antibacterial activity encouraged to work on identification of antibacterial investigation and study on wound healing properties of these medicinal plant. The four different plants extract were combined with equal ratio (50:50) and finished with viscose spun laced non-woven fabric. The PHC1 (Poly Herbal Combination 1), PHC2 (Poly Herbal Combination 2) finished fabrics were tested using the standard disc diffusion method (AATCC 147) against three bacterial species, which are prominently found in wound site *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*. The antibacterial activity revealed that PHC1 has more effective than PHC2. Hence this PHC1 based finished fabric is excellent for developing antibacterial wound care dressing.

Keywords: antibacterial activity, herb, poly herbal combination, wound, wound dressing medicinal plants

Introduction

Infectious disease is one of the leading causes of death worldwide in developing countries [1]. Injury is the loss or damage in apportion or in a part of the body tissue. Combination product that involve two or more medicinal elements in one dosage unit is believed more effective rather than only a single drugs to heal injury [2]. The treatment of most of the infective diseases depends on the usage of antibiotics or antimicrobial drugs [1]. Nature has been the origin of medicine plants, and modern drugs were derived for these natural origin, the contribution of medicinal plants are huge for human health and wellbeing [3]. There are several number of plant products which have antimicrobial activities that could be used also systematically or locally [1]. Textile fabric has been used as some wound materials since antique times, commonly it has the function to stop the wound from infection, absorbing the exudates and help to increase speed of healing [3]. Wound healing, may be referred to as first or second intention. Wound dressings are a medicinal means of cleaning, covering and protective wounds in order to enable curing. Wound healing and the dressing's active really on dissimilar approaches including conventional wet-to-dry [4].

Wound dressing should have certain requirements including short time healing, breathable to permit gases and water vapor interchange, antibacterial and non-toxic. Spun-bonded nonwoven materials have a special specification such as high opacity per unit area, a layered structure which leads to increasing basis weight, great tear strength and high liquid retention, good fray, crease resistance and low drape-ability. Spun-bonded webs could be used in medical applications due to its unique structure and cost-effective properties [5].

Wound management have just become intricate because of new insights into wounds curing and increasing need to

manage complex wound outside hospital. Modern dressing is designed to facilitate the function of wound healing rather than just to protect it. Nonwoven fabric serves as an excellent draping material with its high permeability and larger surface area, which provide an open structure for secondary infection [6]. Nonwoven materials with developed finishes such as liquid repellent and antibacterial bacterial resistance have been developing for applications such as surgical masks, gowns, wound dressing and drapes [7]. Growing awareness of health and hygiene has increased the demand for bioactive or antimicrobial textiles [8].

India has a rich plant life that is widely spread throughout the country. Herbal medicines have been the basis of treatment and cure for several infections and physiological disorders in natural techniques practiced such as Ayurveda, Unani and Siddha [9]. The paste of plant leaves is also used for the treatment of skin diseases by rural people [10]. Modern years have witnessed a renewed interest in exploring natural resources for evolving such combinations. Medicinal plant life is relied upon by 90% of the world's population. In India the use of medicinal plant life as healing agents remains an important component of the traditional medicinal system. A number of plants have been documented for their biological and antimicrobial properties [11].

The growing concentration of consumers on health, hygiene, fashion, comfort and luxury has increased the demand for natural and synthetic fibers with specialty finishes. Similar to the use of nanotechnology and biopolymers for textile finishing, herbal extracts have gained huge fame for luxury textile products. Herbal extracts are used to impart fragrance and antimicrobial, skin nourishing and moth-proofing properties [12]. The aim of the present study is to development of poly herbal finished antibacterial wound

dressings for acute wounds in diabetic patients which give rebirth to the use of age old traditional medications and knowledge into present era. Based on the above facts the study was planned to design a wound care dressing entitled Development of poly herbal finished antibacterial wound dressing.

Materials and Methods

Selection and preparation of plant

The four herbs such as *Tridax procumbens*, *Coleus ambonicus*, *Aclypha indica* and *Vitex nigundo* were selected based on the antibacterial and wound healing properties^[13],^[14],^[15],^[16]. The plants were collected in and around Tirupur district, Tamil Nadu, India. The leaves of all these four plants were carefully collected, cleaned, washed and dried under shade for three weeks. The dried leaves were then made into fine powder by domestic blender and stored in airtight containers for future studies^[3].



Fig 1: Medicinal plants

Preparation of plant extract

In all the four plants powder measuring 4gms was added in four different conical flasks containing 100ml of ethanol. Further the prepared solution was kept over arbor shaking for six to eight hours and the prepared extract then filtered using Whatman No. 1 filter paper. The filtrate was kept at room temperature for complete evaporation of solvent. The plant material after evaporation was used for antimicrobial finishing^[17].

Antimicrobial finish

The poly herbal combination was prepared for increasing the efficiency of antibacterial and wound healing properties. The herbal combination were prepared by mixing two herbs in equal ratios (50:50). *Tridax procumbens*: *Coleus ambonicus* were combined in equal ratio to prepare poly herbal combination 1. *Aclypha indica*: *Vitex nigundo* were combined in equal ratio to prepare poly herbal combination

2. The dried bio activity crude material was dispensed in 1% DMSO solution^[18]. The selected viscose spun lace non-woven fabric was finished with the prepared solution by dip-dry-cure method^[19]. The fabric was then assessed for antibacterial activity against wound infecting pathogens.

Evaluation of Antimicrobial Activity

The leaf extract finished fabrics were subjected to antimicrobial assays by disc diffusion test (Kirby-Bauer) technique.

Microorganisms

The organism used for this study is one Gram positive bacteria *Staphylococcus aureus* and two Gram negative bacteria *Escherichia coli*, *Pseudomonas aeruginosa*^[9].

Preparation of the bacterial inoculum

Bacterial cultures used for the present study were attained from Microbial Type Culture Collection (MTCC). Bacterial cultures included *Staphylococcus aureus*, *Escherichia coli* and *Pseudomonas aeruginosa*. All the cultures were developed in Muller – Hinton broth medium. The inoculums prepared for antibacterial assay. Stock cultures were preserved at 4°C on nutrient agar slant. Active cultures for research were organized by transferring a loop full of culture from the stock cultures into the test tubes containing nutrient broth, that were incubated at 37°C for 24 hours^[20].

Disc Diffusion Method

The disc diffusion test was isolate on Mueller-Hinton agar. The turbidity of the broth was attuned according to 0.5 McFarland standards by adding sterile saline. By dipping a sterile cotton swab into a standardized bacterial culture, a sterile cotton swab was saturated. Lawn culture of the test strain was prepared by swabbing to give a uniform inoculum to the entire surface. The plates were permitted to dry, the finished fabric sample with the diameter of 4 cm were placed on the plate. The plates were incubated at 25°C for 30 minutes and then moved to 37°C for 18 – 24 hours. After incubation the plates were examined and measured the (ZOI) zone of inhibition^[21].

Result and Discussion

Antibacterial Activity

The poly herbal finished (PHC1 and PHC2) viscose spun lace non-woven fabric was analyzed for antibacterial activity against three clinical bacterial isolates namely *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*. The Result of poly herbal finished antibacterial viscose fabric is presented in table 1 and plate 1. From the table value it is evident that poly herbal viscose fabric has ability to fight against test microbes. While comparing the result of PHC1 and PHC2. PHC1 (*Tridax procumbens* and *Coleus ambonicus*) show better result against test bacteria. PHC1 showed efficient result against *S.aereus* and *P.aeruginosa* with 25mm and 17 mm ZOI. PHC2 showed the ZOI of 25mm against *E.coli* which is higher than PHC1.

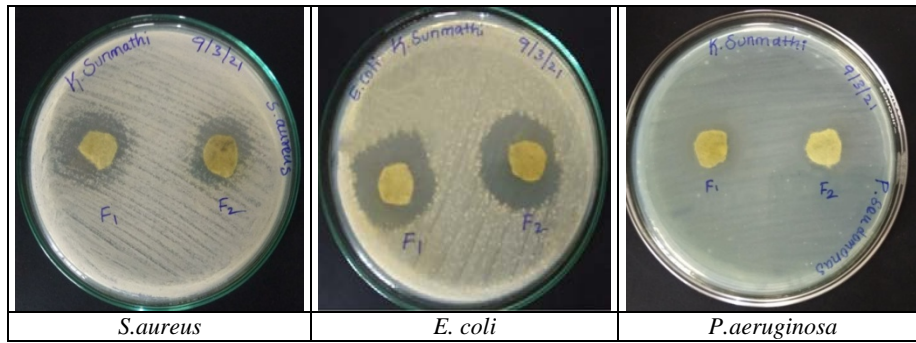


Plate 1: Antibacterial activity against wound pathogens

Table 1: Antibacterial Activity of poly herbal coated viscose fabric

S. No	Herb treated Viscose fabric	Zone of inhibition in (mm)		
		<i>S. aureus</i>	<i>E. coli</i>	<i>P. aeruginosa</i>
1	PHC1	25	22	17
2	PHC2	20	25	12

Note: PHC1: poly herbal combination 1, PHC2: poly herbal combination 2

Conclusion

This research work provides the knowledge on fabric treated with herbal extract. Since the selected herbs are abundantly available in many countries this work can be scaled up to commercial level. The PHC1 finished viscose spun laced non-woven fabric was utilized for developing medicated wound care dressing. This medicated layer can directly applied on the wound site for healing. On the basis of research and observation, it is concluded that combining different herbal combination will enhance the medicinal properties in herb. These kind of herb treated spun lace non-woven fabric will have good market in future and which move the result in positive direction.

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