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ENCAPSULATION OF POLY HERBAL EXTRACT FOR THE DEVELOPMENT AND EVALUATION OF MEDICAL TEXTILE MATERIALS

KEYWORDS: poly herbal, antimicrobial, nano encapsulation, micro encapsulation

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ABSTRACT

In this study poly herbal finish on cotton fabric by *Abutilon indicum, Tridax procumbenz, Cassia fistula and Cassia auriculata* was described. Soxhlet apparatus extraction method had been adopted in the processes,Hexane,Ethyle acetate and Methanol were used as solvents in the extraction processes photochemical screening and solvent screening were done to identify the better activity of the extracts. Later, each extracts and polyherbal extracts were under gone antimicrobial testing. Fabric finishing adopted three finishing methods such as Dip and Drying, Micro encapsulation and Nano encapsulation. Physical, mechanical, geometrical properties of both finished and control fabric had been analysed. FTIR, anti allergy, SEM analysis and wound scratch assay analysis was done to determine the efficiency of the polyherbal finish fabric which proves the wound healing property of the poly herbal finished fabric.

INTRODUCTION

Medicinal plants are the important source of bioactive compounds including antioxidant and antibacterial activity. They serve as a source of many potent and powerful drugs in many countries (Mathivanan, k. and Sivaprakasam, E. (2014). According to the World Health Organization (1999), the current estimate suggests that many developed countries have a great proportion of the population making use of traditional practice of health, especially the use of the medicinal plants.

Generally, textile is an excellent substrate for microbial growth, because they are made of organic materials providing a good base for biofilm attachment and the human sweat, which is retained by the textiles, provides nutrients necessary for microbial growth.Textile materials, in particular, the garments are more susceptible to microorganisms present in environment and human skin. The control of undesirable effects of microbes on textiles is becoming an important issue in textile industry. Initially, the primary objective of the finish was to protect textiles from being affected by microbes. Antimicrobial fabrics are important not only in medical applications but also in terms of daily life usage. The antimicrobial finishes to fabrics can prevent microbial growth on textiles (Rajendran, R. & Radhai, R. (2014).

Medicinal plants are important substances for the study of their traditional uses through the verification of pharmacological effects and can be natural composite sources that act as new anti-infectious agents (Priscila Ikeda and Ushimaru (2007). This research study was conducted in order to develop an Eco-friendly natural antimicrobial finish for health care textiles for medical application. The herbal extracts from three plants were applied on the cotton fabrics by three different application methods i.e. finish. The three finishes selected were dip and drying method, micro encapsulation and nano encapsulation .The finished fabrics were subjected to various tests such as Antibacterial analysis along with Visual inspection, Geometrical properties, Mechanical properties, Comfort properties and Absorbency properties. The adherence and long lasting nature of the finish was also tested with the SEM analysis and FTIR analysis. The finishing technique by the Microencapsulation method in the fabric sample 100% cotton fabric possessed all the expected parameters like durability of the fabric, increased fabric thickness, absorbance, air permeability and antimicrobial activity.

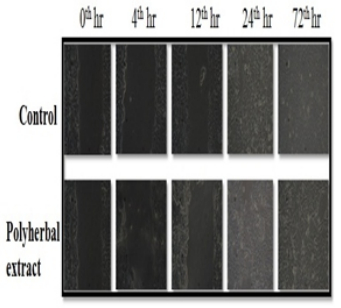

Figure:1 *Invitro* Wound Scratch Assay

S.No	Sample	Zone of inhibition (mm)				
		1	2	3	4	5
1	Negative control	-	-	-	-	-
2	Positive control	22	25	30	28	31
3	Tridax procumbens (500 µg/ml)	13	14	13	12	13
4	Abutilon indicum (250µg/ml)	16	15	20	23	15
5	Cassia fistula (250µg/ml)	15	18	16	17	19
6	Cassia auriculata (250µg/ml)	19	20	22	25	26

TABLE 1: MIC VALUES OF HERBAL EXTRACT

S.No	Methanolic extraction	MIC values (µg /ml) of herbal extract				
		1	2	3	4	5
1	***Abutilon indicum***	250	125	250	250	1000
2	***Tridax procumbens***	500	125	500	250	500
3	***Cassia fistula***	250	250	250	500	500
4	***Cassia auriculata***	62.5	125	250	250	62.5

1. Candida albicans 2. Pseudomonas aeruginosa 3. Escherichia coli 4. Staphylococcus saprophyticus 5. Aeromonas hydrophi

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TABLE-3:- ANTIBACTERIAL ACTIVITY OF POLYHERBAL EXTRACT BY WELL DIFFUSION METHOD

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S.No	Sample	Zone of inhibition (mm)					
			1	2	3	4	5
1	Negative control		-	-	-	-	-
2	Positive control		25	31	28	20	22
3	**Polyherbal extract**	50 µl	14	12	11	15	10
		100 µl	18	15	17	19	15
		150 µl	20	17	20	21	18
		200 µl	22	20	22	23	20

1.Candida albicans 2. Pseudomonas aeruginosa , 3. Escherichia coli ,4. Staphylococcus saprophyticus 5. Aeromonas hydrophila

EXPERIMENTAL PROCEDURE

The Experimental procedure of the study consisted of four phases with the following aspects. deals with the selection of yarn , fabric, pre-treatment , scouring, bleaching of fabric and Selection of herbs. For this study yarn was been purchased from textile committee of Coimbatore and used for the study. The yarn converted into a fabric at the width of 18" and length of 8 meter was made to be weaved for the study. For this study, four healthy and live herbal plant parts were selected. The botanical names of the selected herbs are as follows: *Senna auriculata, Abutilon indicum, Cassia fistula and TRIDAX PROCUMBENS* were collected. Extraction of secondary metabolites from plants, Preliminary phytochemical screening, Antimicrobial analysis of individual extracts, and antimicrobial analysis of poly herbal extracts are done. The extraction process was done in three stages, such as drying, grinding and extraction. Active compounds from the leaves of *Senna auriculata, Abutilon indicum, Cassia fistula and TRIDAX PROCUMBENS* were extracted using soxhlet extraction technique. Three solvent types such as Hexane, Ethyl acetate and methanol were followed for all the selected four herbs. The extracts were screened for phytochemical constitutes present. Qualitative phytochemical analysis of the leaf extracts was analyzed using Harborne method and Trease and Evans methods. Preliminary screening was carried out to test the presence of the following phytoconstituents, Carbohydrates, Tannins, Saponins, Flavanoids, Alkaloids, Quinones, Glycosides, Cardiac Glycosides, Terpenoids, Triterpenoids, Phenols, Coumarins, Phlobatannins, Steroids and Phytosteroids, Anthraquinones. The antibacterial activity of herbal extracts was studied by agar well diffusion method and determined MIC against selected pathogenic bacteria *Aeromonas hydrophila* (MTCC 1739), *Staphylococcus saprophyticus* (MTCC 6155), *E. coli* (ATCC 25922), *Pseudomonas aeruginosa* (ATCC27853) and *Candida albicans.* The microorganisms were collected from Microbial type culture collection (MTCC) and AMERICAN TYPE CULTURE COLLECTION (ATCC). Synthesis of Microencapsulation and Nano encapsulation methods and application of multi-functional finishes in the selected samples and verification of qualities such as anti-bacterial activity had been adopted. The selected fabrics were finished with the herbal extracts using Dip and drying, Microencapsulation and Nano encapsulation methods. The fabric was evaluated using five categories of evaluation such as visual inspection, physical, mechanical, comfort and absorbency property test. The above evaluation was done to find out the impregnation of multifunctional finishes in selected fabrics. Geometrical properties-the geometric properties like Fabric weight and Fabric Thickness were analyzed. Mechanical properties-the Tensile strength, water holding capacity of the multi-functional finished fabrics were tested. Comfort properties -the wearing comfort of the consumer was the primary objective of this study, which was determined using the air permeability test. Absorbency properties-the water absorbency test, sinking test and the wickabilty test was also determined as a part of evaluation. The scanning electron microscopy was used for confirming the binding of finishes and alignment on to the fabric sample. The main goal of FTIR spectroscopic analysis was to determine the chemical functional groups and to know to what extent the molecules of the finishing chemicals are attached with fiber molecules of the specimen.

RESULTS AND DISCUSSION

Preliminary screening was carried out to test the presence of the following phytoconstituents, Carbohydrates, Tannins, Saponins, Flavanoids, Alkaloids, Quinones, Glycosides, Cardiac Glycosides, Terpenoids, Triterpenoids, Phenols, Coumarins, Phlobatannins, Steroids and Phytosteroids, Anthraquinones Minimum inhibitory concentration of the herbal extract was tested by the two-fold serial dilution method. Higher values of MIC 125& 250µg /ml and 500 &1000µg /ml for the methanolic extracts of *Abutilon indicum, Tridax procumbens, Cassia fistula* respectively against *Candida albicans , Pseudomonas aeruginosa, Escherichia coli ,Staphylococcus saprophyticus* , *Aeromonas hydrophila* and tabulated in table 1. Polyherbal extracts of Tridax Procumbens(500µg /ml),Abutilon indicum(250µg /ml), Cassia auriculata(250µg /ml) and *Cassia fistula*(250µg /ml) have maximum antimicrobial activity in all the cases, there is a good zone of inhibition ranging from 19-26mm for Cassia auriculata and tabulated in table 2. At a concentration of 1.25 mg/ml, the poly herbal extract showed low antimicrobial activity against *E.coli* (9 mm),*Aeromonas hydrophila* (9 mm), *Staphylococcus saprophyticus* (9 mm),and *Pseudomonas aeruginosa* (9 mm). At a concentration of 2.5 mg/ml, the poly herbal extract showed low antimicrobial activity against *E.coli* (9 mm), *Aeromonas hydrophila* (10 mm), *Staphylococcus saprophyticus* (10 mm) and *Pseudomonas aeruginosa* (10 mm). At a concentration of 5 mg/ml, the poly herbal extract showed antimicrobial activity against *E.coli*(10 mm), *Aeromonas hydrophila*(10 mm),Staphylococcus saprophyticus(10 mm),and *Pseudomonas aeruginosa* (10 mm). Streptomycin (10µg/disc) showed high degree of inhibition against *E.coli* (19 mm), *Aeromonas hydrophila* (22 mm), *Staphylococcus saprophyticus* (20 mm) and *pseudomonas aeruginosa* (23 mm) and tabulated in table3.Polyherbal extracts of *Tridax Procumbens, Abutilon indicum, Cassia auriculata and Cassia fistula* exhibited 90-95% wound healing activity at 72 hrs where complete healing of the cells was observed which confirms the wound healing property of Polyherbal extract. The finished fabric (Non Woven polyester) patched on the normal skin was observed for the specified period of time for the development of the symptoms related to contact dermatitis allergy.

CONCLUSION

The overall results after the study showed that poly herbal finish fabric, was exhibiting good retention of the herbal finish. Regard to antimicrobial finish tests carried with *S. saprophyticus* (gram positive bacteria), *E. coli* (gram negative bacteria), *P. aeruginosa* (gram negative bacteria) and *A. hydrophila* (gram negative bacteria), the Nano and microencapsulated finished fabrics has been proved for higher efficiency, preventing infections than unfinished and dip finished fabrics and exhibited better reduction of bacterial count per cent. Polyherbal extracts of *Tridax Procumbens, Abutilon indicum, Cassia auriculata and Cassia fistula* exhibited 90-95% wound healing activity at 72 hrs where complete healing of the cells was observed which confirms the wound healing property of Polyherbal extract. Monolayer of fibroblast cells monolayer was scratched and wound closure was followed at 0, 1, 4, 12, 24 and 72 hrs in the presence of treated and control cultures.

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