ANALYSING OF *INDIGOFERA ASPHALATHOIDES* COATED FABRIC FOR ITS THERAPEUTIC EFFICIENCY

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ABSTRACT

Medical Textiles are also known as healthcare textiles. Patients with chronic skin diseases may have an increased risk of Cutaneous and other infections. The transdermal drug delivery system enable the drugs to penetrate the surface of skin, skin layers itself and systemic Circulation to treat skin Disease and to heal the wounds. In traditional Indian treatment, oils were used for treating Skin disease. Now a- days "Ayurvastra" cloths treated with various herbs are being developed for treating Skin diseases. The present study focuses on application of Indigofera aspalathoides (Sivanar Vembu) extract on to the fabric for treating skin disease. Indigofera aspalathoides is selected based on its Anti- microbial, Anti- Viral and wound healing properties. These properties are exhibited by its phytoconstituents such as Amino acids, Carbohydrates, Terpenoids, Tannins, Alkaloids, Flavonoids, Saponins, Glycosides and Lipids. The herb is extracted and applied onto the spun bond Polypropylene fabric (disposable nonwoven fabric which is mainly used for surgical gowns) through Pad- Dry- Cure method with and without Permeation Enhancers (olive oil, Papain & DMSO). Permeation Enhancer facilitates the transport of drug molecules across skin by temporarily altering its permeability. Hostapal MRN is used as a wetting agent, in order to improve the wettability of Spun bond polypropylene nonwoven fabric. Finished fabric is then tested for Anti- microbial properties and rate of drug delivery. This paper discusses the performance of the finished non woven in the above said aspects. The study confirms that the finished non woven can also be used for various applications where Anti- microbial and wound healing activity is required. The developed non woven fabric can be used as wraps and also Apparels. The developed finishing technology can also be extended to Woven's and Knits.

Keywords: Anti Bacterial Property, Indigofera Asphalathoides, Medical Textile, Polypropylene, Transdermal Drug Delivery System

I INTRODUCTION

Combination of textile and its application in medical sciences has resulted into a new field called medical textiles. Development of medical textiles is really meant for converting the painful days of patients and surgeons into the comfortable days. The importance of textile materials in the medical field is credited to their excellent physical properties, such as strength, extensibility, flexibility, suppleness, air and moisture permeability and

wicking. As the healthcare industry is growing enormously in India, the demand for the Medical Textile is also on the rise. In this paper, textiles used for treating skin problems have been focused [3].

Chronic skin diseases include common inflammatory dermatoses like atopic and seborrheic dermatitis and psoriasis with peak incidences in childhood and young adulthood. Patients with chronic skin diseases may have an increased risk of cutaneous and other infections [2]. As the side effects of the chemical drugs become apparent, natural remedies become the part of the green revolution. Herbalists used herbs for centuries in the treatment of various Skin diseases. Later on, Ayurvastra cloths (Cloths treated by herbal extracts) were used by Ayurveda health clinics in the treatment of a broad range of diseases.

The aim of this work is to develop herbal finished textiles to treat chronic skin disease especially eczema through transdermal drug delivery system.

II ECZEMA AND ITS CAUSES

Skin disease is a common disorder of predominantly the superficial layers of the skin which affects all age groups from the neonate to the elderly stage. Atopic eczema is one of the most common skin diseases which affects up to 20% of children and 1–3% of adults in most countries of the world[8]. Atopic eczema often has a genetic component that leads to the breakdown of the skin barrier. This makes the skin susceptible to trigger factors, including irritants and allergens, which can make the eczema worse[7].

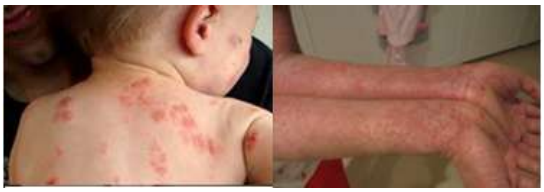

Fig 1- Eczema

III DRUG DELIVERY SYSTEM

Transdermal drug delivery is the application of drug on the skin surface so that it can permeate through the skin and reaches the systemic circulation.

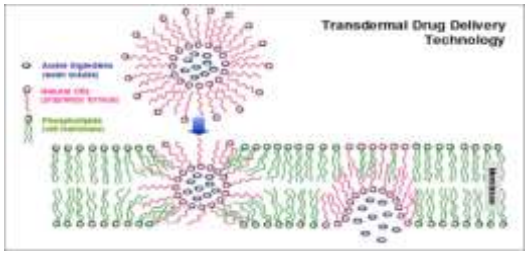

Fig 2-Transdermal drug delivery Technology.

Transdermal patch is applied over the skin and it remains in position for a specific period of time as hours, days or weeks and releases the drug for that period of time. The routes of drug absorption through the skin are intercellular, intracellular and transappendageal. The drug has to pass through various layers of the skin after release from the transdermal patch. The major problem in transdermal drug delivery is the barrier of stratum corneum to the permeation of the drug and can be overcome by permeation enhancing techniques.

IV MATERIALS AND METHODS

4.1. Materials

4.1.1. Herbs used for Eczema Treatments

The Siddha System of Medicine (Traditional Tamil System of medicine), which has been prevalent in the ancient Tamil land, is the foremost of all other medical systems in the world. Its origin goes back to B.C 10,000 to B.C 4,000. Various medicinal plants are being used to treat skin disease in siddha[9]. Among those herbs, *Indigofera aspalathoides* and *Eclipta prostrate* have been selected for the study based on its good Anti bacterial, Anti Viral and Anti fungal activities. Properties of herbs are due to the phyto constituents like Amino acids, Carbohydrates, Terpenoids, Tannins, Alkaloids, Flavonoids, Total phenol, Saponins, Glycosides, and Lipids.

4.1.2. Permeation Enhancer for Transdermal Drug Delivery System (TDDS):

The outer most layer of the skin, the stratum corneum provides a protective barrier that prevents the loss of physiologically essential substances and provides greatest resistance to penetration and it is the rate limiting step of percutaneous absorption. Penetration enhancers are the agents which increase the permeability of skin, maintain the drug level in blood and improve the efficacy of drugs. These are nontoxic, inert substances having no therapeutic value but enhance the absorption of drug through skin by different approaches of penetration enhancement[4].

Dimethyl Sulphoxide, Olive oil and papain has been selected for the present study. DMSO being the chemical can be used as a control. Olive oil has been selected based on its surfactant and moisturising nature. Papain has been selected as it is widely used in medical field for antifungal, antibacterial and anti-inflammatory properties.

4.1.3. Spunbond Polypropylene fabric:

The standard fabric for basic protective apparel; formed by bonding fibers together to form a single layer of breathable, woven-like material. Its main advantages are economy and comfort. These protective garments are available in single-layer spunbonded polypropylene for basic coverage[6]. Spunbond polypropylene nonwoven fabric of 60 GSM is used for our study.

4.1.4. Wetting Agent:

Hostapal MRN, a commercial grade chemical supplied by M/s. Clariant chemicals is used as a wetting agent to improve the absorbency of the PP nonwoven material and facilitate the application of the extract

4.1.5. Test bacterial cultures

The test cultures, Escherichia coli, Staphylococcus aureus, Enterococcus Faecalis and Proteus species used in the study were the significant pathogens isolated from the patients with wound infections (from Kovai Medical Center and Hospital, coimbatore).

4.2. Methods

4.2.1. Extraction of herb:

The extract is prepared using maceration process. In maceration (for fluid extract), whole or coarsely powdered plant-drug is kept in contact with the solvent in a stoppered container for a defined period (7 days) with frequent agitation until soluble matter is dissolved. This method is best suitable for use in case of the thermolabile drugs. 50 grams of herb is added in 500 ml of methanol and extracted using maceration method.

Fig: 3 Extract preparation

Indigofera aspalathoides- Sivanar Veembu showed better Anti microbial activity**.** Thus sivanar vembu has been extracted and used for further studies[1].

4.2.2. Application of herbal extract on nonwoven:

Four different fabric samples are prepared as given in the Table 1. The fabric treated with extract is passed through the squeeze rollers in the padding mangle with 2 bar pressure. It helps to penetrate the extract into the fabric and also remove the excess solution from the fabric surface. After finishing, the fabrics are placed in drying chamber at 80°C for 5 minutes. Due to this process the finished fabric is dried. After drying the fabric, it is placed into curing chamber around at 100° C for 5 minute, which helps in fixing the extract permanently on to the fabric[5].

Sample	Product description
1.NED	Herbal Extract- 30 gpl, DMSO- 60 gpl , Wetting Agent- 5 gpl.
2. NEP	Herbal Extract- 30 gpl, Papain- 2.5 gpl , Wetting Agent- 5 gpl.
3.NEO	Herbal Extract- 30 gpl, Olive oil- 2.5 gpl, Wetting Agent- 5 gpl.
4.NEI	Herbal Extract- 30 gpl, Wetting Agent- 5 gpl.

Table 1: Polypropylene samples prepared through padding mangle

4.2.3. Anti bacterial and antifungal test methods:

4.2.3.1. Antibacterial test method

The antibacterial activity of finished fabric was tested according to EN ISO 20645 against the test bacterial cultures. The finished cotton fabric with the diameter of 6 mm was placed on the surface of Nutrient agar medium which was swabbed with the bacterial cultures. The plates were incubated at 37 ºC for 24 hours to measure the zone of inhibition in millimeters formed around the fabric.

4.2.3.2. Anti fungal test methods:

AATCC 30 – Test method to determine the susceptibility of textile materials to mildew and rot and to evaluate the efficacy of fungicides on textile materials. Each AATCC 30 subpart is treated as a separate antifungal test.

The antibacterial and anti fungal tests were done for the following samples:

a) *Indigofera aspalathoides* and *Eclipta prostrate* herbal extracts to select the best extract

b) *Indigofera aspalathoides* herbal extract was combined with four different types of permeation enhancers. These combinations were tested.

c) The PP nonwoven fabrics coated with the four different combinations of herbal extract and permeation enhancers.

4.2.4. In Vitro Drug release Evaluation - Franz diffusion cell:

In this method transdermal system is placed between receptor and donor compartment of the diffusion cell. The transdermal system faces the receptor compartment in which receptor fluid i.e., buffer is placed. The whole assembly is kept on magnetic stirrer and solution in the receiver compartment is constantly and continuously stirred throughout the experiment using magnetic beads. At predetermined time intervals, the receptor fluid is removed for analysis and is replaced with an equal volume of fresh receptor fluid. The concentration of drug is determined spectrophotometrically.

Fig 4: Simulated Franz diffusion cell

V RESULTS AND DISCUSSION

5.1. Selecting the best herb for application on the PP fabric

5.1.1. Antibacterial activity of herbal extract by well diffusion method

S.No	Herbs	Con.c	Zone of inhibition (mm)	
			Bacillus	*S.aureus*
1	P1	1X	19	19
		2X	20	23
2	P2	1X	18	19
		2X	20	24

Table 2: Antibacterial activity of herbal extract

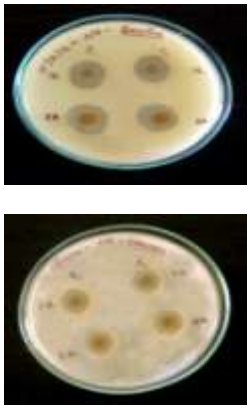

Fig 5: Antibacterial activity of herbal extract

Both the herbs have good Antibacterial activity against the *Bacillus and S. aureus* due to the presence of various phytoconstituents in the herb.

5.1.2. Antifungal activity of herbal extract by well diffusion method:

S.No	Herbs	Conc.	Zone of inhibition (mm)	
			A.niger	*Candida albicans*
1.	P1	1X	17	17
		2 X	16	23
2.	P2	1X	0	0
		2X	0	14

Table 3: Antifungal activity of herbal extract

Fig 6: Antifungal activity of herbal extract

Sivanar vembu Showed better antifungal activity against *A.niger and Candida albicans* due to the presence of various phytoconstituents in the herb.

(Note: P1-*Indigofera aspalathoides*, P2- *Eclipta prostrate*, 1x-2.5g/50ml, 2x-5g/50ml)

5.2. Antibacterial activity of the herbal extract coated PP fabrics

Samples	Bacillus (mm)	S. aureus (mm)	Enterococcus Faecalis (mm)	Escherichia coli (mm)	Proteus spp. (mm)
1.NED	14	19	18	23	14
2.NEP	19	22	20	22	18
3.NEO	24	28	22	22	22
4.NEI	18	22	20	20	20
5.Ctrl (Amx)	11	13	28	-	19

Table 4: Antibacterial activity of the coated fabrics

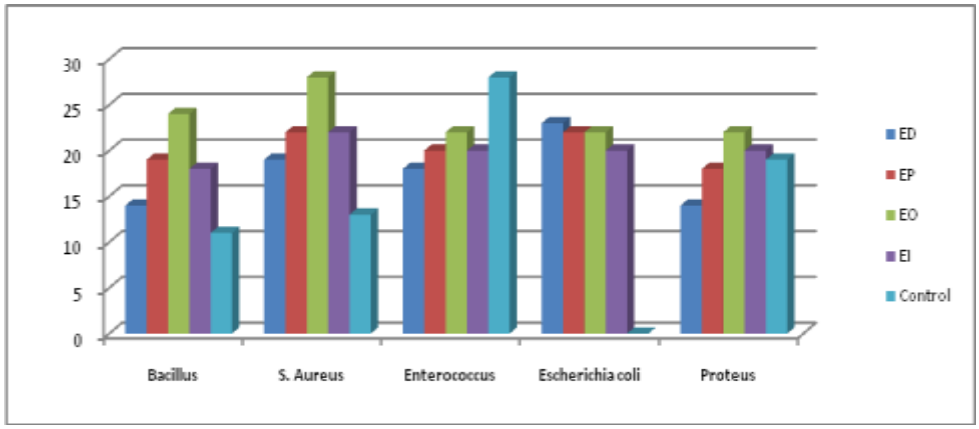

Fig 7: Antibacterial activity of the coated fabrics

Fabric coated with extract and olive oil showed better antibacterial property, which is mainly due to the phytoconstituents present in the herb and due to the better permeation enhancing rate of the olive oil.

5.3. Drug release Studies

5.3.1. Bioactive compounds in *I. aspalthoides*

Amino acids, Carbohydrates, Terpenoids, Tannins- 34.59, Alkaloids, Flavonoids, Total phenol- 47.38, Saponins, Glycosides, and Lipids. UV spec reading was taken to determine the peak value. Maximum absorbance of 0.926 is obtained at 665 nm. This peak shows the presence of various components. Since Phenol is the major constituent and its absorbance range is at 650 nm, phenol content is determined in the study. Catechol equivalent to phenol is used as a standard to determine the concentration of phenol released from the coated fabrics.

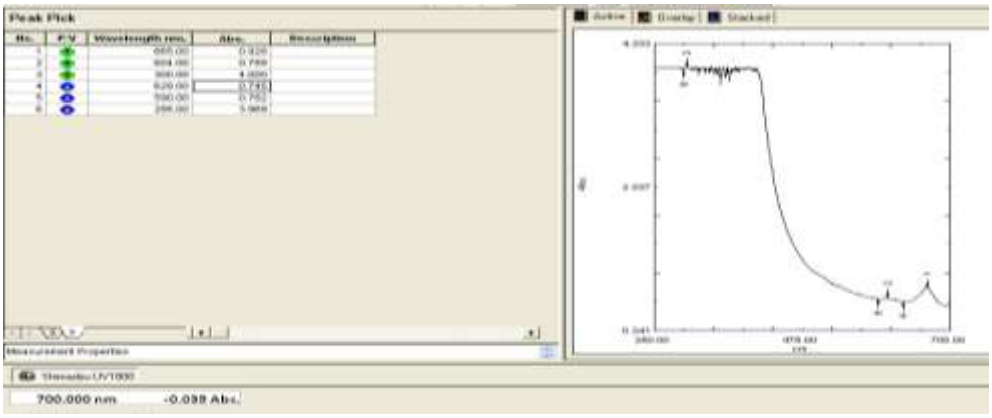

Fig 8: UV Spectophotometer graph to determine the peak value.

5.3.2. Determination of total phenolics:

The extract were taken in a 10ml glass tube(0.2ml) and made up to a volume of 3ml with distilled water. 0.5ml Folin ciocalteau reagent (1:1with water) and 2ml Na_2CO_3(20%) sequentially added in each tube. A blue color was developed in each tube because the phenol undergoes a complex redox reaction with phosphomolibdic acid in folin ciocalteau reagent in alkaline medium which resulted in a blue colored complex, molybdenum blue. The test solution were warmed for 1 minute, cooled and absorbance was measured at 650nm against the reagent used as a blank. A standard calibration plot was generated at 650nm using known concentrations of catechol. The concentrations of phenols in the test samples were calculated from the calibration plot and expressed as mg catechol equivalent of phenol/g of sample.

5.3.3. Calibration plot for phenol determination:

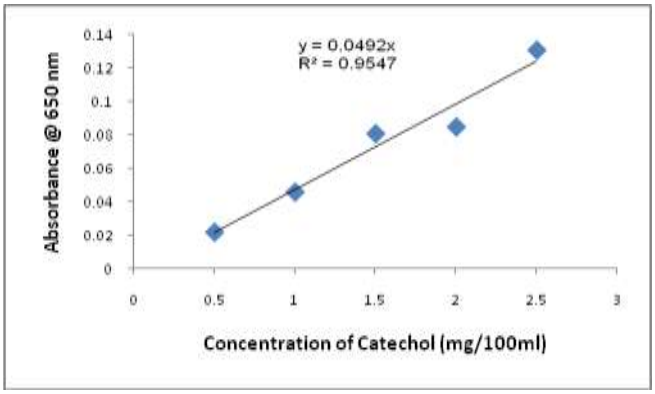

Fig 9: Standard calibration plot catechol equivalent to phenol

5.4.4. Determining the concentration

From the graph, Y= 0.0492 X (X= Concentration, Y= Absorbance).

Therefore, Concentration(X) = Absorbance(Y)/0.0492.

5.4.5. Amount of drug Release

Amount (mg) = Conc. * Dilution factor * Correction factor * Volume of medium

Release rate of Phenolic content from the coated fabric has been determined and tabulated below.

5.4.5.1. Drug release rate- Sample 1 (NED)

Time	Absorb.	Conc. (mg/100ml)	Amount (mg/100ml)
0th hr	0.000	0	0
After 2 hrs	0.001	0.020325203	2.03252
After 4 hrs	0.003	0.06097561	6.09756
After 6 hrs	0.008	0.162601626	16.2602
After 18 hrs	0.014	0.284552846	28.4553
After 20 hrs	0.017	0.345528455	34.5528
After 22 hrs	0.018	0.365853659	36.58537
After 24 hrs	0.019	0.386178862	38.61789
After 26 hrs	0.019	0.386178862	38.61789

Table 5: Drug release rate- Sample 1 (NED)

5.4.5.2. Drug release rate- Sample 2 (NEP)

Time	Absorb.	Conc. (mg/100ml)	Amount (mg/100ml)
0th hr	0.000	0	0
After 2 hrs	0.004	0.081300813	8.130081
After 4 hrs	0.009	0.182926829	18.29268
After 6 hrs	0.010	0.203252033	20.3252
After 18 hrs	0.014	0.284552846	28.45528
After 20 hrs	0.016	0.325203252	32.52033
After 22 hrs	0.017	0.345528455	34.55285
After 24 hrs	0.018	0.365853659	36.58537
After 26 hrs	0.019	0.386178862	38.61789

Table 6: Drug release rate- Sample 2 (NEP)

5.4.5.3. Drug release rate- Sample 3 (NEO)

Time	Absorb.	Conc. (mg/100ml)	Amount (mg/100ml)
0th hr	0.000	0	0
After 2 hrs	0.011	0.223577236	22.35772

After 4 hrs	0.012	0.243902439	24.39024
After 6 hrs	0.013	0.264227642	26.42276
After 18 hrs	0.015	0.304878049	30.4878
After 20 hrs	0.016	0.325203252	32.52033
After 22 hrs	0.017	0.345528455	34.55285
After 24 hrs	0.018	0.365853659	36.58537
After 26 hrs	0.019	0.386178862	38.61789

Table 7: Drug release rate- Sample 3 (NEO)

5.4.5.4. Drug release rate- Sample 4 (NEI)

Time	Absorb.	Conc. (mg/100ml)	Amount (mg/100ml)
0th hr	0.000	0	0
After 2 hrs	0.003	0.06097561	6.097560
After 4 hrs	0.004	0.081300813	8.130081
After 6 hrs	0.006	0.12195122	12.19512
After 18 hrs	0.013	0.264227642	26.42276
After 20 hrs	0.015	0.304878049	30.48780
After 22 hrs	0.016	0.325203252	32.52033
After 24 hrs	0.017	0.345528455	34.55285
After 26 hrs	0.017	0.345528455	34.55285

Table 8: Drug release rate- Sample 4 (NEI)

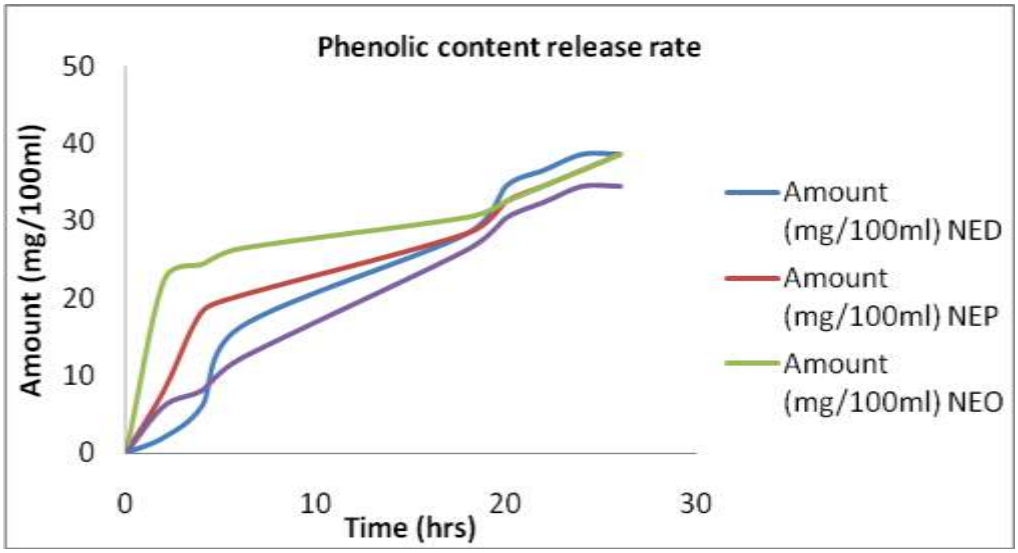

Fig 10: Phenol release rate from the coated fabric

Drug released by the coated fabric of diameter $4cm^2$ has been determined. Comparing all the samples, release rate of fabric coated with extract and olive oil is better from the initial hours.

VI CONCLUSION

In this project, Anti-bacterial finish has been applied to the nonwoven polypropylene fabric. Extract of Indigofera aspalathoides has been applied onto the fabric with three different Permeation enhancers .The performance of the finished non woven fabric has been studied and found that fabric treated with extract and olive oil showed better anti microbial properties and efficient drug release rate.

Thus, the sample treated with extract and olive oil has much better properties for preventing Skin disease. The drug release rate is also much effective in this sample. And it is suggested that, this fabric could be used for preventing skin disease and also for other applications were anti microbial finish is required. And also it gives benefit to the people in health and cost wise. In addition, it is environmental friendly.

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