ABSTRACT

In the last couple of decades, technical textiles have been the focus area in the field of textile technology and textile engineering. Textiles as a sector have grown phenomenally and applied in wide range of technical fields creating avenues for cross-functional development between various fields of engineering and basic textile engineering. This has led to the development of performance oriented textile products for human comfort and health care.

An attempt has been made through this research work in the area of applications of plants and their preparations, in the field of medical textiles, where knowledge on ethnopharmacology, phytopharmacognosy and textile engineering are essential.

Secondary metabolites of plants, also termed as phytochemicals, are present in various parts of plants. Traditional practitioners of natural medicine have successfully used various methods to extract the curative compounds from plants for their preparations to treat ailments. Herbal extracts and plant products are coated on textile surfaces and used in medical textiles. Such products will have the functionality of textiles as well as the curative ability of the herbal compound. Curative textiles, also known as "therapeutic textiles", refer to textiles used in medicinal field that play the primary role in curing diseases and are a step ahead in preventive textiles

In this research work, investigation has been carried out on various plants suitable for the development of curative bandages. Herbal extracts that are effective in the treatment of lymphological, phlebological and muscular-skeletal disorders have been chosen for application on bandage substrates. In order to isolate the active chemicals from parts of selected plants, extraction

techniques followed by traditional practitioners were studied and extractions were carried out for the selected parts of plants. A novel pyrolyser using slow pyrolysis as its working principle was designed and developed for this research work. Investigation of the phytochemical composition of the plant extracts is vital to understand the curative ability of the extract. The extracted herbal preparations were applied on different bandage substrates to develop curative medical bandages. The characteristics of the coated bandages were studied and the performance of the curative bandage was evaluated by conducting field trial.

Compression bandages and fixation bandages are the textile substrates used in this research work. Compression functionality augmented with herbal functionality can result in an herbal coated bandage which can also be used in the treatment of muscular-skeletal disorders such as arthritis, rheumatism etc. Aided and supported by the sub-bandage pressure exerted by the bandage, the active compounds from the coated extract are likely to penetrate the human skin and help in curing. The human skin is a permeable membrane and acts as a effective medium from which transdermal absorption takes place For this research, diseases to be treated were chosen purely based on the usage of bandages in regular conventional treatment.

A novel pyrolyser was designed and developed based on the principle of slow pyrolysis to improve upon the traditional extraction process after a thorough study and analysis.

Dodonaea viscosa, Ziziphus jujuba, Moringa oleifera, Cedrus deodara and Celastrus paniculatus were finalized for this research work. Extracts from the parts of first two of them were obtained using pyrolysis extraction technique using the newly developed pyrolyser and the remaining

three plants using solvent extraction technique.Visual and chemical similarities between the extracts of D.viscosa and Z.jujuba obtained by traditional and scientific methods validate the design and principle of the pyrolyser.

The screening for the functional groups and the identification of the phytochemicals present in the plant extracts were done using Fourier Transform Infrared Spectroscopy (FTIR) and chromatography techniques respectively. Extracts from the pyrolyser were oily in nature and were characterized using Gas Chromatograph-Mass Spectrometer (GC-MS). Other three extracts, derived using the solvent extraction technique, were powdery in nature and High-Performance Liquid Chromatography (HPLC) and Thin-Layer Chromatography (TLC) techniques were used. The phytochemicals that are likely to be responsible for the curative nature of the extracts used in the treatment of various human disorders are identified. The extract from D.viscosa contained pyrolysates of smooth muscle relaxing flavonoids. Sedative cyclopeptide alkaloids were identified in the stem extract of Z.jujuba. Extracts from the leaves of M.oleifera, heartwood of C.deodara and seed of C.paniculatus were found to contain tannins, volatile oils and saponins respectively. These plant chemicals have curative ability against muscular-skeletal disorders.

The oily extracts from pyrolysis extraction technique were converted into microcapsules using sodium alginate as wall material and coated on compression bandage. The powdery extracts from solvent extraction technique were coated on fixation bandages in two ways namely weft coating and fabric coating. The extensibility being the vital characteristic of the bandage, trials were done to optimise the pick-up percentage without affecting the extensibility.

An antibacterial assessment of the coated bandages was done by measuring the zone of inhibition. Basically, the woven bandage substrate has no antibacterial activity of its own and the property has been imparted by coating plant extracts.

The FT-IR analysis of the coated bandages show the peaks corresponding to the phytochmicals of corresponding extract and also additionally the peaks pertaining to that of the functional groups in the base fabric substrate. This confirms the oily extract is encapsulated in the microcapsules and also effective coating of the preparations on the surface of the bandages. Scanning Electron Microscope (SEM) analysis confirmed the random distribution of microcapsules on the surface of the coated compression bandage. Coated bandages were assessed for their extensibility as per Deutsches Institüt für Normung (DIN) standards. Field trial was conducted to evaluate the performance of the coated bandages in comparison to control bandages.

Adaptation of slow pyrolysis as a method to extract oily substances from parts of plant for medicinal use, done in this research, is a pioneering work in the field of analytical and applied pyrolysis. This research has substantiated the historical use of the extracts of selected plants by identifying the curative compounds in the extracts and is a development in the field of ethnopharmacology. Coating of plant extract on the textile bandage imparts additional functionalities like antibacterial property and curative ability which are added characteristics to the basic textile material. Augmentation of bandage functionality, demonstrated in this research, is a step forward in the field of curative textiles.