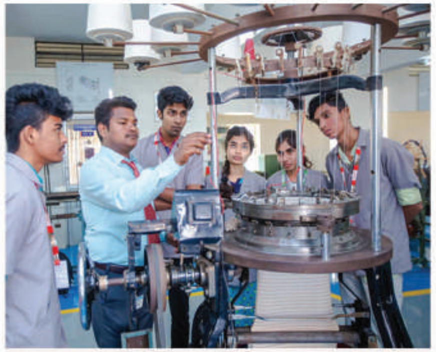
Yarn Manufacturing Laboratory



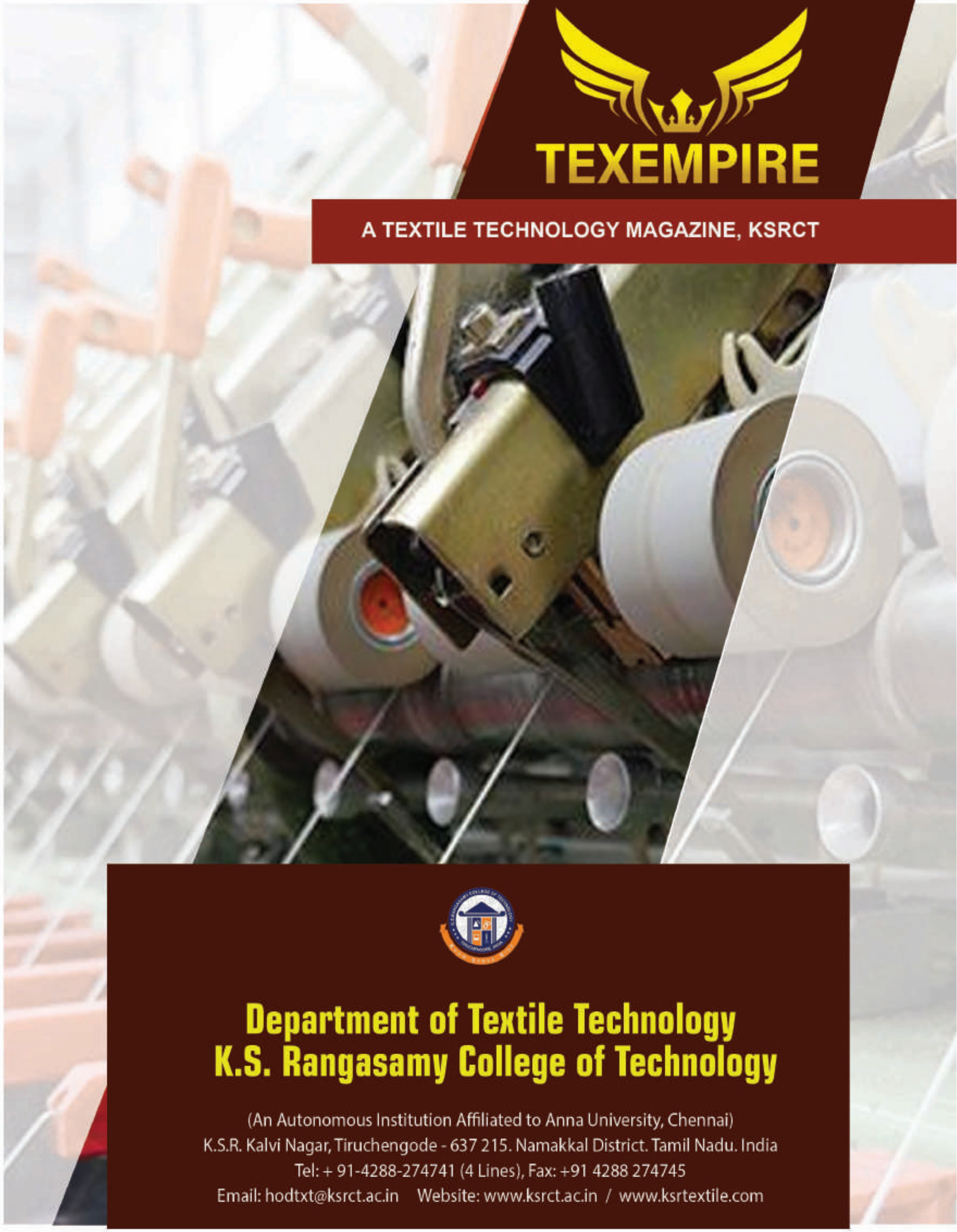
Fabric Manufacturing Laboratory

Textile Testing Laboratory

Textile Chemical Processing Laboratory

Garment Construction Laboratory

Technical & Innovative Textile Laboratory



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TEXEMPIRE

A TEXTILE TECHNOLOGY MAGAZINE, KSRCT

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"The future belongs to those who believe in the beauty of their dream.."

Thiru. R. Srinivasan, B.B.M., MISTE

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KSR EDUCATIONAL INSTITUTION

We at K.S.Rangasamy College of Technology has begun to bestow the most pioneering magazine **"TEXEMPIRE"**, volume 10, issue 1, the biannual magazine of department of textile technology. The escalation in the field of textile is an exemplary way to serve up to the progress of a nation a boom that serves the people with intense research and development is textile the contributions made by learned textile technologist, researchers and student have made the textile to flourish in an unexpected way, with absolute faith I accept the wisdom that this magazine provides an insight towards the major thrust areas of textile provoking the minds of upcoming textile technologist. I wish to express my gratitude to the editorial board members, faculty and students of the Department of Textile Technology for bringing out this impressive magazine.

" Children must be taught how to think, not what to think."

Dr.R.Gopalakrishnan M.E., Ph.D

PRINCIPAL

KSR COLLEGE OF TECHNOLOGY

The transformed technological science that unites various interdisciplinary aspects for the welfare of each and every individual is textile. **"TEXEMPIRE"** magazine by the Department of Textile Technology of K.S.Rangasamy College of Technology will help to enhance our knowledge by promoting the exchange of experience. An encyclopedia of textile could solve all the issues related to the past and ready to answer the feature issues by indulging in the present status is Textile Technology. The thought of individual author towards the textile and technology has been compiled by the volume, editors to make the students expertise and make their contribution for the enhancement of various fields of textile. Their enthusiasm to impart knowledge to their colleagues forms the foundation of Textile and is gratefully acknowledged.

I convey my appreciation to the editorial board members faculty and students of the department of Textile Technology for their effort to bring out this magazine and wish them all success in their endeavors..

"Fashion is the armor to survive the reality of everyday life"

Dr.G. Karthikeyan M.Tech., Ph.D

HEAD OF THE DEPARTMENT

KSR COLLEGE OF TECHNOLOGY

Welcome to the inaugural issue of **TEXEMPIRE**, the magazine dedicated to the dynamic world of textile technology and fashion innovation. It is my pleasure to introduce this publication, aimed at serving as a beacon of inspiration, knowledge, and insight for all who are passionate about textiles and fashion. Our Department of Textile Technology at K S Rangasamy College of Technology has a proud history of excellence and innovation. Since our establishment in 1997, we have been at the forefront of textile education, offering B.Tech., M.Tech., and Ph.D. programs. Recognized as a research center by Anna University, Chennai, our commitment to advancing the field through cutting-edge research and industry collaboration is unwavering. In this first issue of TEXEMPIRE, we howcase the breadth and depth of our xpertise and reativity. Highlights include research on environmentally sustainable composites using banana and jute fibers, innovative fabric designs sing the miss pick effect, and the development of eco-friendly baby diapers from hemp and kenaf fibers. these projects underscore our dedication to sustainability and nnovative solutions to contemporary challenges. We also celebrate the achievements of our students and alumni, whose projects and research reflect the rigorous education and hands-on experience they receive here. Our alumni network plays a crucial role inventorying current students, offering guidance, scholarships, and career opportunities. is you explore TEXEMPIRE, I hope you feel spired by the innovation and dedication hat define our department. Thank you for our support and interest in our work. together, We can continue to push the secondaries of textile technology and fashion.

Development of Bio-Active Wound
Care Dressing Material by Using Spirulina Extract

PALLA SRINIVASU, S PRASANNA and S RAVIKUMAR

Abstract- Medical textile is one of the highly developing field in technical textile. There are wide range of textile materials used in medical field in which bandages made of textile material plays a vital role in wound dressing. Our purpose of the study is to increase the efficiency of wound healing activity without using any toxic chemicals, which causes various side effects later on. Wound dressing material is made of various natural substances like spirulina(microalgae), AloeVera and Ocimum Basilicum (basil seed). Each component has its own function in wound healing due to various functions like anti-oxidant, anti-inflammatory, anti-fungal, anti-viral and digestive enzymes. Antioxidants are compounds, which inhibit oxidation. Oxidation is the process of chemical reaction that can produce free radicals, there by leading to chain reactions that may damage cells of living organisms. Antiinflammatory is the property of a substance or treatment that reduces inflammation or swelling. Resist in growth of fungus and virus, which enters the body parts, is known as anti-fungal and antiviral respectively. The digestive enzyme of the ocimumbasilicum (basil seed) is applied over the fabric above the spirulina extract. When it gets contact with water molecules in the blood it converts into gelatinous and enters into the wound, which heals the wound quicker than the other medicines available

INTRODUCTION A wound is a type of injury which happens relatively quickly and damages the skin tissue such as torn, cut, or punctured (an open wound), or where blunt force trauma causes a contusion (a closed wound). In pathology, it specifically refers to a sharp injury which damages the Epidermis of the skin. The healing of a wound is a complex, dynamic and continuous process aiming at there pairing of damaged tissue. The efficient treatment system of a wound is very important to improve the healing process, in terms of both quality and time, as well to reduce the costs associated with the treatment. Currently, there is a great variety of wound-care products, available in the market, including creams, solutions, dressings or skin tissue engineering substitutes. Among these products, bioactive wound dressings represent an effective method for wound treatment, presenting a good relationship between clinical efficacies and manufacturing cost. However, for some types of wounds, such as infected wounds, use of bioactive wound dressings cannot be sufficient to promote the healing process, as many of these materials do not present therapeutic activity (e.g. antibacterial and anti-septic characteristics). In order to solve this limitation, some dressings, based on natural bioactive compounds, were developed incorporating different protein and compounds to reduce the growth of microorganisms in wounds. The continuous administration of protein contents in infected wounds though associated with the development and spread of antibiotic resistant strains of bacteria presents at is factory clinical results To address this challenge, the potential of bioactive wound dressing material is being developed, consisting of Spirulina plantensis, Aloevera and Ocimumbasilicum seed for bio medical applications. Seaweeds are present in a large scale as unused protein rich content. Spirulina contains large percent of beta carotenoids and associated proteins. This kind of material can be used to produce the hygienic material. So the aim of the project is to produce the medical textile product with the help of spirulina. SPIRULINA Spirulina plantensis is a filamentous blue green algae, it grows naturally in fresh, brackish, sewage water and even in saline environment. It grows through photosynthesis, hence, can be termed as vegetative ©

RESEARCH AND ENGINEERING ood. It has been already affectively promoted as anatural food. It holds valuable compounds like poly unsaturated fatty acids (PUFA), phycocyanin and phenolic, which act as antioxidants. It is also used as nutraceutical agent due to the presence of macro and micronutrients like carbohydrates, proteins, essential fatty acids, vitamins (B-complex, vitamin E and carotenoids), magnesium, selenium, copper, manganese, zinc and iron. Several strains of blue green algae are well known for diverse biological activities such as anti bacterial, antifungal, cytotoxic, algaecide ,immune suppressive 9 and antiviral activities. Aloe Vera is a green colour plant with thick, fleshy, tapered, spiny, marginated and dagger shaped leaves growing from a short stalk near ground level. Aloe Vera is the most widely used species, both commercially and for its therapeutic properties. This plant contains two materials with a juicy consistency: the first, a yellow exudate containing a high concentration of anthraquinone-type compounds, which have been used for decades as cathartics and purgatives, and the second, a clear mucilaginous gel that has been used since ancient times for the treatment of burns and other wounds. II.

MATERIALS AND METHODS MATERIALS The raw materials used in this work are non-woven fabric, spirulina plantens is, aloe vera and ocimumbasilicumseed. Non-woven Fabric The material selected for this study is spun bonded non-woven fabric consist of Viscose/cotton in the blend ratio of 80:20. The spun bonded non-woven fabric is selected because it has excellent water absorbency, breathability and hygiene property. The fabricis sourced from Rade MYRA non-woven industry pvt ltd, Ahmedabad. Spirulina Spirulina platensis is a potential source of high value compounds with functional propertiese. g., phycocyanins, carotenoids, phenolicacidsandomega3andomega-6polyunsaturated fatty acids. Spirulina is a great source of beta-carotene (pro vitamin A) and vitamin B-12. Vit B-12 is very useful in treatment of pernicious anemia. Carbohydrates -Glucose, rhamnose, mannose, xylose and galactose etc are found in microalgae biomass. Spirulina plantensis is directly purchased from Vetraspirulina private limited, Coimbatore. Aloevera Aloe vera is consists of 98-99% water and the remaining 1-2% contains the active compounds, such as aloesin, aloin, aloeemodin, aloemannan, acemannan, aloeride, naftoquinones, methyl chromones, flavonoids, saponin, sterols, amino acids, and vitamins. The levels of these compounds vary according to species, strain, and growth conditions.ThepharmacologicalactionsofAloeveraincl udeanti-inflammatory, antibacterial, antifungal, antioxidant, immune-boosting and hypoglycemic properties. Aloe vera leaves are collected from nearby village. Ocimum Basilicumseed Sweet basil seeds are also known as sabja seeds, falooda seeds, tukamaria seeds. Ocimumbasilicum is the technical name, which represents the basil seed. Ocimumbasilicumseedis purchased from Jayasuryastores, Tiruchengode. Chemicals The chemicals such as ethanol are purchased from Microtroniks Quali-Tech chemicals, Agra. The other chemicals Such as diclofenac, chloro form and other auxiliaries are purchased from Tiruchengode.

METHODS PREPARATION OF SPIRULINA WOUND DRESSING MATERIAL. Chemicals Required Ethanol Distilled water Glassware & equipment required Beakers

COATING OF SPIRULINA/ ALOE VERA/ OCIMUM BASILICUM SEEDONNONWOVENFABRIC The spun bonded non-woven is washed in distilled water and dried in oven to get better absorbing efficiency. The dried non-woven fabric is weighed in weighing balance, based on the weight of the fabric amount of extract required is calculated. The non-woven fabric is placed in a polymeric tray and the ethanol extract of Spirulina is poured inside the polymeric tray. The trey is left undisturbed for about 15minutes, effective absorption of spirulina extract will takes place. Finally the fabric is dried in the room temperature for about 18 hours. The ethanol content evaporates in air and spirulina coated nonwoven material is covered with aluminium foil sheet, then stored for further use. After24hours, the fabricis placed on a smooth surface.

CHARACTERISTICS OF SWELLING A weighed 20 x 20 mm2 dried sample was soaked in distilled water (~250 c). After 48h soaking, swelling was measured. The swollen sample was taken from the water; excess surface water was wiped off with a filter paper, and weighed immediately. Swelling was calculated as: Swelling= Mw-M0 M0 Where M0 was the sample mass before immersion and Mw was the mass after immersion. FTIR Fourier Transform Infrared Spectros copy, also known as FTIR Analysis or FTIR Spectros copy, is an analytical technique used to identify organic, polymeric, and, in some cases, inorganic materials. The FTIR analysis method uses infrared light to scan test samples and observe chemical properties. © JUN 2019 | IRE Journals | Volume 2 Issue 12 | ISSN: 2456-8880 IRE 1701274 ICONIC RESEARCH AND ENGINEERING JOURNALS 236 CONCLUSION Spirulina is a protein rich seaweed which has an antioxidant compound (β-carotene) in it this helps in healing the wound faster. As like anti-oxidant antimicrobial activity is also an important factor in quick healing so that Aloe vera extract is coated along with spirulina, extract in a spun bond non-woven fabric. This shows a faster wound healing in Wister albino rats. Thus the fabric coated with spirulina aloe vera and ocimum basilicummucilaginous layer acts as a wound healing product

ANTI MICROBIAL FINISH FOR HERBAL DYED FABRIC BY USING BIO-ENZYME

HEMANATH.V.N, JITHU.R ,VENKATRAMANAN.K and VIMAL.K

Abstract- The eco friendly anti microbial finish given to the cotton fabric by extract of tulsi, lemon grass, aloe vera to the bio enzyme treated fabric. Textiles with improved anti microbial functionality with variety of garments worn close to the skin and also in other medical application for the infection control. The herbal plants was chosen as it constituents the luteol in which was found to be effective in the prevention of harmful diseases. The test applied to the antimicrobial finished effective material

INTRODUCTION GENERAL INSTRUCTION This chapter deals about the eco-friendly product to the nature without affecting the environment. The antimicrobial finish has been given to the fabric to prevent against the harmful diseases spread to the human body. The natural method of process will reduce the water purification process. An antimicrobial is an agent kills microorganisms or inhibits their growth. Large surface area and ability to retain moisture enable micro organisms growth in textile products. The growth of microorganisms reduces the product mechanical strength, stains the fabric and lets other more pernicious microbes grow. This is one of the reasons apparel are packed in airtight bundles. The antimicrobial diseases can be caused by bacteria and fungi with the help of giving particular finish to the fabric which can prevent the human beings from the diseases, and also to reduce the odor smell in the fabric for the longtime usage. Antimicrobial textiles are used where moisture and microbes meet. The materials are use in a variety of applications including healthcare, hygiene, medical devices, sportswear, food packing, storage. In the pretreatment process instead of using chemicals we are using enzyme to make the process to reduce the water pollution caused to the environment and it can be prevent from the waterborne diseases. By using the enzyme the processing time can be reduced and the usage of temperature also reduced. At the moment we try to discover our product as a natural way of processing anddyeingof100%cotton fabric.

ANTIMICROBIAL FINISHES IN TEXTILE The chemical which is used as an antimicrobial activity, it can be applied to the textile material by exhaust, pad-dry-cure, coating, spray and foam techniques. All antimicrobials does not exhibit the same nature. The vast majority of antimicrobials work by leaching or moving surface from which they are applied. This is the mechanism used by leaching antimicrobials to poison a micro organisms. Such chemicals have been used for decades in agricultural applications with mixed results. Besides affecting durability and useful life, leaching technologies have the potential to cause a variety of other problems when used in garments. These include their negative effects because, they can contact the skin and potentially effect the normal skin bacteria, cross the skin barrier, or have the potential to cause rashes and other irritations. A more serious problem with leaching technologies has to do with their following for the adaptation of microorganisms. An antimicrobial with a completely different mode of action than the leaching technologies is a molecularly bonded un convential technology. The bound unconventional antimicrobial technology,

RESEARCH AND ENGINEERING of action that relies on the technology remaining affixed to the substrate killing micro organisms as they contact the surface to which it is applied. Effective levels of this technology do not leach or diminish over time. When applied, the technology actuallypolymerizeswiththesubstratemakingthesurfac eantimicrobial.Thistypeofantimicrobial is used in textiles that are likely to have human contact or where durability is of value. Garments are supposed to go through the more wear and tears during the chemical processing and its service time. The following facts fulfilled for the satisfactory performance of the finish: Durability to wash, dry clean and hot press process. It should not be hazardous to the producer, final user and the environmental conditions. To avoid the disinfection NATURAL EXTRACTS Natural plants having the antimicrobial activity can be used for the medical purposes. From this the natural extract are taken and further process were done and coated on textile material. The following were used for the antimicrobial activity here: Tulsi leaf Aloevera Lemon grass Orange peel Pomegranate peel

MATERIALUSED Sourced and bleached 100% cotton fabric was used for the antimicrobial finish. Leaves of tulsi (Ocimumtenuiflorum), Leaves of aloe vera (Aloe barbadensis), lemongrass (cymbopogon), peel of orange (Citrus AurantiumDulcis), peel of pomegranate (L.

TYPES OF COATING Pad-Dry-Cure PADDING Padding mangle consists of main frames that are usually fabricated construction, to with stand vibrations and heavy workloads. While the cloth passes on the padding mangle machine no slackness should occur in fabric either in weft or warp directions and the we ft thread of the cloth should remain parallel to the nip at the squeezing point. The nip rollers (often called bowls) are the key to successful pad dyeing. In general, two-bowl nips are preferred for lightweight or standard fabrics running at moderate speeds, whereas three-bowl arrangements are intended for heavier or more densely woven qualities that may be more difficult to wet out and thus require a

CONCLUSION From the detailed investigations, we found that, the fabric treated with natural extracts show high antimicrobial property. Since, this type of finish has having durability to washing, it can be applied for long bed ridden patient dress, Bed covers, surgical coats etc.,. The combination of Aloe vera & Pomegranate shows better antimicrobial activity than the other combinations. However, we used some natural extracts as mordant for long lasting the antimicrobial activity to the treated fabric. From, our study we found that, the combination of aloe vera & pomegranate yields high anti- microbial property when using the natural mordant. Hence, this natural extract anti-microbial finish will be more benefitable for the society by preventing the bacterial infection with a greener environment.

LIGNO CELLULOSIC MATERIALS FOR AUTOMOTIVE INTERIORS

ISWARYA, S.KAVYA and A.RAAJKKAMAL

Abstract- Nonwoven materials have been manufactured using needle punch, thermal and chemical bonding. Therefore, currently waste recycled materials present good alternative to synthetic material. Interior application by innovative material in experimental approach becomes a new area. Based on result the natural fiber based nonwoven is suitable for automotive interior applications. Natural fibers are nowadays increasingly employed for making nonwovens, replacing the synthetic materials due to economic and/or environmental considerations. Extracted natural fibers present satisfying mechanical properties that allow it to be an important source for nonwoven textiles materials. The interest in using natural fibers such as different plant fibers and wood fibers as reinforcement in plastics has increased dramatically during recent years. The purpose of this study is to show the feasibility to of making nonwoven textiles with natural fiber. Therefore, the natural fibers: bamboo, jute, banana blended together in the required proportion. Webs are prepared using this natural fiber using cards in regular width. Then the needling is used to consolidate the fibrous structure. These nonwoven can lead to different useable products in automobile in order to improve the value. Synthetic fibers are majorly used in automotive interiors. In order to

reduce the usage of synthetic fibers we developed natural fiber composites for interior applications. Productions of nonwoven fabric from synthetic yarns can reduces problems generated by manmade fibers. In this report it is described how the natural fibers are used as an alternate for synthetic fibers. Therefore, currently waste recycled materials present good alternative to synthetic material. Further we will study the properties of the yarn and its application in different field. In this project report I am going to discuss about the usage of natural fiber in automotive interior. Based on the result the natural fiber-based nonwoven is suitable for automotive interiors.

INTRODUCTION Non-woven fabric is a fabric-like material made from staple fibre (short) and long fibres (continuous long), bonded together by chemical, mechanical, heat orsolvent treatment. The term is used in the textile manufacturing industry to denote fabrics, such as felt, which are neither woven nor knitted. Some nonwoven materials lack sufficient strength unless densified or reinforced by a backing. Non-woven fabrics are broadly defined as sheet or web structures bonded together by entangling fiber or filaments (and by perforating films) mechanically, thermally or chemically. They are flat or tufted porous sheets that are made directly from separate fibres, molten plastic or plastic film. They are not made by weaving or knitting and do not require converting the fibres to yarn. Typically, a certain percentage of recycled fabrics and oil-based materials are used in non-woven fabrics. The percentage of recycled fabrics vary based upon the strength of material needed for the specific use. In addition, some non-woven fabrics can be recycled after use, given the proper treatment and facilities. For this reason, some consider non-woven a more ecological fabric for certain applications, especially in fields and industries where disposable or single use products are important, such as hospitals, schools, nursing homes and luxury accommodations. Nonwoven fabrics are engineered fabrics that may be single-use, have a limited life, or be very durable. Nonwoven fabrics provide specific functions such as absorbency, liquid repellence, resilience, stretch, softness, strength, flame retardency, washability, cushioning, thermal insulation, acoustic insulation, filtration, use as a bacterial barrier and sterility. These propertiesare often combined to create fabrics suited for specific jobs, while achieving a good balance between product use-life and cost. They can mimic the appearance, texture and strength of a woven fabric and can be as bulky as the thickest paddings. In combination with other materials they provide a spectrum of products with diverse properties, and are used alone or as components of apparel, home furnishings, health care, engineering, industrial and consumer goods. The interest in using natural fibers such as different plant fibers and wood fibers as reinforcement

plastics has increased. The need for materials having specific characteristics for specific purposes, while at the same time being non- toxic and environmentally friendly, is increasing, due to a lack of resources and increasing environmental pollution. Studies are ongoing to find ways to use ligno cellulosic materials in place of synthetic materials as reinforcing fillers. Thus, research on the development of composites prepared using new fibrous When they have to choose between varieties of products, manufacturers consider following criteria: economics, durability, aesthetics, process ability, mould ability, added benefits, which are main driving forces of nonwoven in construction industry worldwide. Composites are heterogeneous in nature, created by the assembly of two or more components with fillers or reinforcing fibers and a compactable matrix. Composites are one of the most widely used materials because of their adaptability to different situations and the relative ease of combination with other materials to serve specific purposes and exhibit desirable properties. The main aim of the project is to give broad outlook about the textile materials usedin automotive interior applications. Nonwoven materials are increasingly used in many industries such as Medicine and Healthcare, Household Domestic uses, Building industry, Agriculture, Horticulture & Aquaculture, Automotive and Transport, Geosynthetics, Clothing. Jute, Banana and Bamboo plant fibers are used. This natural fiber offer an environmental friendly solution for manufacturing textile composite parts and components while providing performance better compared to other products. Nonwoven materials have been manufactured using needle punch, thermal and chemical bonding. Therefore, currently waste recycled materials present good alternative to synthetic material. Interior application by innovative material in experimental approach becomes a new area. Based on result the natural fiber based non woven is suitable for automotive interior application.

NEEDLE PUNCHING A needle punched nonwoven is a fabric made from webs or batts of fibersin which some of the fibers have been driven upward or downward by barbed needles. This needling action binding point is a set of fibers with various orientation, which are bonded by friction forces. The needle board is the base unit into which the needles are inserted and held. The needle board then fits into the needle beam that holds the needle board into place. The feed roll and exit roll are typically driven rolls and they facilitate the web motion as it passes through the needle loom. The web passes through two plates, a bed plate on the bottom anda stripper plate on the top. Corresponding holes are located in each plate and it is through these holes the needles pass in and out. The bed plate is the surface the fabric passes over which the web passes through the loom. The needle scarry bundles of fiber through the bed plate holes. The stripper plate does what the name implies; it strips the fibers from the needle so the material can advance through the needle loom.

NEEDLE PUNCHING PROCESS MATERIAL USED AND METHODOLOGY • In the study, Jute, Bamboo and Banana fibres are used as raw materials for the non-woven. • Fabric production. Before production, the length, fineness, and cross-sectional appearance of the fibres. • These fibres are used in the proportion of Jute (40%), Banana (20%), and Bamboo (40%). EXPERIMENTAL PROCEDURE • The interest in using natural fibres such as different plant fibres and wood fibres as reinforcement in plastics has increased dramatically during recent years. Jute, Banana fibres are used. This natural fibre offer an environmentally friendly

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN TECHNOLOGY manufacturing textile composite parts and components while providing performance better compared to other products. • Jute is one of the most important natural fibre in terms of cultivation and usage. Jutefibre has some unique physical properties like high tenacity, bulkiness, sound and heat insulation property, low thermal conductivity, antistatic property etc. Jute fibres are always known as strong, coarse, environmental friendly, andorganic. •

CONCLUSION ❖ The synthetic materials cause more pollution and it leads to cancer like dreadful diseases so we replace it with natural fibers. ❖ Replacing of synthetic materials can reduce this type of problems and we can use as a textile product. ❖ Nonwoven fabric can produced using natural lingo cellulosic materialswhich are produced into fabric. ❖ Nonwoven fabric are used for home textiles for carpets, rugs, cleaningtowel etc., ❖ The lingo cellulosic nonwoven are produced into fabric using needle punched technique. ❖ In this project we have reduced usage of synthetic materials which are pollutants. ❖ From this we can reduce pollution and problems. ❖ This project can be commercialized and also ecofriendly.

A NON-WOVEN FABRIC WOUND DRESSING CONTAINING LAYER – BY – LAYER DEPOSITED HYALURONIC ACID AND CHITOSAN

Abstract

Novel wound dressings composed of non-woven cotton (NWC) fabric and multilayer of hyaluronan (HA) and chitosan were built using layer-by-layer assembly technique. Factors affecting the building up of that dressings such as HA concentration, number of coating layers and nitrogen content of the NWC fabric quaternized form were studied. Meanwhile, some physico-chemical properties of such dressings were investigated. Moreover, to enhance the antibacterial properties of the aforementioned dressings, Silver nano-particles (Ag NPs) were prepared and incorporated as a functional additive in the final HA layer of such dressings. Factors affecting the building up of that dressings such as HA concentration, number of coating layers and nitrogen content of the NWC fabric quaternized form were studied. The results obtained showed that: i) increasing of HA concentration from 0.25 to 1.0% is accompanied by a gradual reduction in the swelling properties and an improvement in the gel fractionas as well as antibacterial properties of treated fabric along with a decreasing in extents of stiffness, air permeability and the relative water vapor permeability of treated fabric, ii) increasing of steeping time of coated samples results in an improvement in percent swelling of these samples. TEM image of the prepared Ag-NPs depicts that the particle size of that nano-particles was <13 nm. Furthermore, the prepared dressing surface was characterized via scanning electron microscope. The EDX of Ag NPs loaded dressings confirmed the presence of Ag NPs onto such dressings with Ag - content of 0.24% (w/w).

The thermogravimetric analysis assured that the prepared dressings based on quaternized NWC fabric have higher thermal stability than the un-quaternized form.

Introduction

The skin is considered as the largest organ of a body and formed by three layers. The epidermis is the outer layer is mainly composed of a protein namely keratin. This layer is responsible for protection against the environment. The dermis is the middle layer made up of living cells and includes nerves and blood vessels. The subcutaneous fat the third layer is mostly responsible for insulation and trauma absorbency

A wound is a disruption in the continuity of the anatomical tissues resulting from the exposure to a physical or thermal factor. Wound healing is a complex and dynamic process of tissue regeneration and growth progress. It proceeds via four continuous phases, namely haemostasis, inflammation, proliferation and maturation or remodeling

A dressing material is applied to a wound to promote healing and protect that wound from external factors and conditions. Many types of wound dressing materials are available in the wound care market for all types of wounds. The proper selection of a material for a particular wound is very important to achieve faster healing. Wound dressings are categorized based on their nature of action into passive products, interactive products and bioactive products The latter, are produced from bio-materials having healing properties. They are characterized by their biocompatibility, biodegradability and non-toxic properties and prepared generally from natural or synthetic polymers like chitosan, hyaluronic acid, alginate and collagen and polyester and poly-propylene. To enhance a wound healing process, the biological dressings are sometimes combined with growth factors and antimicrobials

Hyaluronic acid, also known as hyaluronan, is a high molecular weight linear polysaccharide consisted of disaccharide repeats of N-acetylglucosamine and glucuronic acid. Hyaluronic acid is one of the most hydrophilic polymers in nature. The viscoelastic nature of hyaluronic acid as well as its biocompatibility and non-immunogenicity has rendered it to be used in a number of medical applications such as supplementation of joint fluid in arthritis and acceleration of tissue repair and wound healing

Chitosan is a natural polysaccharide composed of D-glucosamine and N-acetyl-D-glucosamine being derived by the partial de-acetylation of chitin obtained from the shells of shrimps, crabs and other crustaceans. Chitosan is one of the most valuable bio-polymers in the biomedical and pharmaceutical fields because of its porous structure, haemostatic properties, water binding capacity, antibacterial activity, biodegradability, low immunogenicity, biocompatibility, non-toxicity, and anti-tumor properties. It also has an adequacy to stimulate cell proliferation and histoarchitectural tissue organization .

On the other hand, hydrogels are three-dimensional polymeric networks. They have the ability to absorb large amounts of water or biological fluids due to their hydrophilic nature. Hydrogels are called physical gels if the secondary forces such as ionic and/or H-bonding forces play the main role in forming the network. Chemical gels having networks composed of different macromolecular chains crosslinked and joined by covalent bonds Recently, multilayer structures can be formed by the so called layer-by-layer assembly technique.

Results and discussion

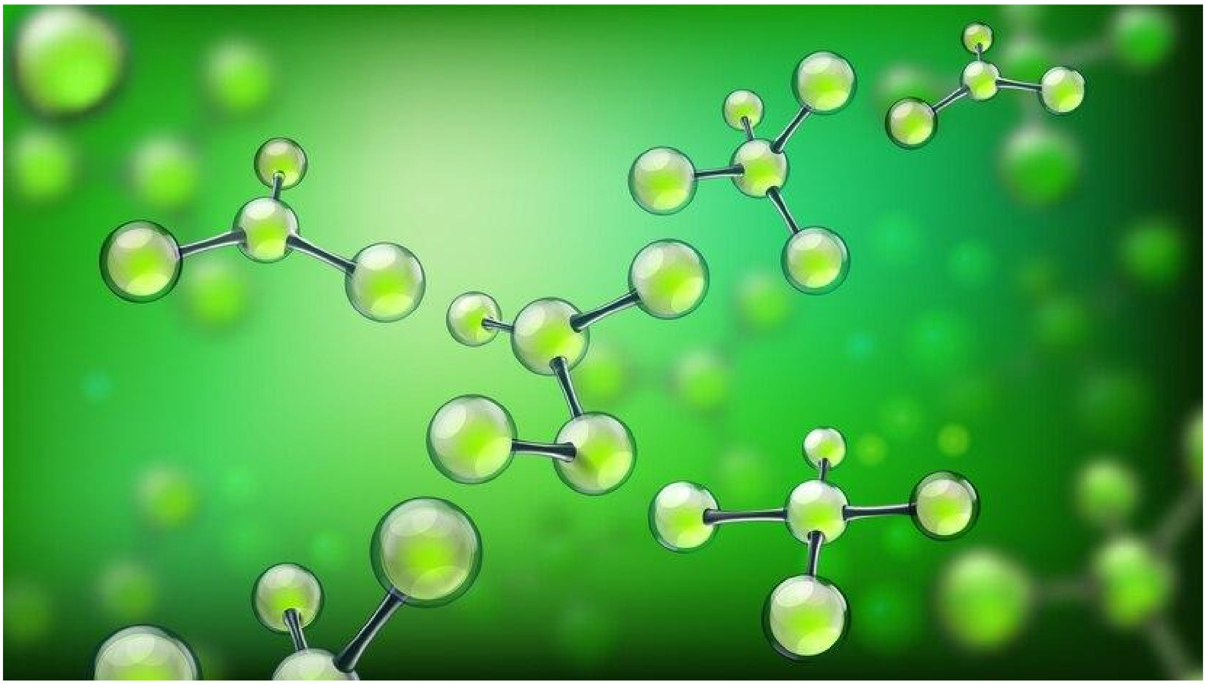
Currently, many researchers focus their studies to develop biomedical materials that can achieve optimum functionality [1,2,[21], [22], [23], [24]]. Consequently, combining the merits of both chitosan and hyaluronan properties in a wound dressing containing such biopolymers may fulfill all the criteria for optimum wound healing. The existence of these biopolymers as layer-by-layer deposits indeed causes strong electrostatic interaction at the interface of each layer that in addition to

Conclusion

Newly wound dressings were built up of non-woven cotton fabric and multilayer of hyaluronan and chitosan using layer-by-layer assembly technique. Factors affecting the building up of that dressings such as HA concentration, number of coating layers and nitrogen content of the NWC fabric quaternized form were studied. The results obtained showed that: i) increasing of HA concentration from 0.25 to 1.0% is accompanied by a gradual reduction in the swelling properties and an improvement in the gel

Single Bath Desizing, Scouring, and Bleaching Using Enzymes: An Eco-Friendly Approach

Sasi Kumar S P, Deepanrajan S, Praveen L V, Praneshkumar CM



Abstract

The demand for sustainable textile processing has driven research into enzymatic solutions. This article examines the application of enzymes in single-bath desizing, scouring, and bleaching processes. Enzymes such as laccase, cellulase, and catalase offer significant environmental benefits, reducing water and energy consumption while improving fabric quality. The study details the enzymatic mechanisms, process optimizations, and performance metrics compared to conventional chemical methods. Results demonstrate improved fabric absorbency, whiteness, and eco-sustainability, emphasizing the potential of enzymatic approaches in the textile industry.

Introduction

Background

Traditional textile processes rely heavily on chemicals, leading to environmental pollution and fabric degradation. Enzymatic processes provide an eco-friendly alternative by leveraging biological catalysts to achieve similar or superior results under milder conditions. This study focuses on single-bath enzymatic treatments that consolidate desizing, scouring, and bleaching, thereby optimizing efficiency.

Objectives

The primary goals are:

- To assess the efficacy of enzymes in combined textile pre-treatments.
- To evaluate improvements in fabric properties and environmental metrics.
- To compare enzymatic and chemical processing methods.

Literature Review

Advances in Enzymatic Processing

Recent advancements highlight the role of enzymes in achieving specific textile processing goals. Enzymes like laccase and cellulase target starch removal, enhance fiber softness, and improve whiteness while operating at lower temperatures and neutral pH levels. This reduces energy and water usage significantly compared to chemical processes. Additionally, novel enzyme formulations have enabled applications in non-traditional textile substrates, expanding their industrial utility.

Studies also emphasize the environmental advantages of enzymatic processing. For example, enzyme-based methods eliminate the need for caustic soda and chlorine, common in conventional processes, thus reducing effluent toxicity and enabling easier wastewater management. Reports have also demonstrated that enzymatic treatments result in enhanced fiber elongation and tensile strength compared to their chemically treated counterparts.

Enzymes in Textile Processing

- **Amylases**: Used for desizing to remove starch-based sizing agents, improving the uniformity of subsequent processes.
- **Cellulases**: Reduce pilling and enhance fabric softness through microfibril hydrolysis. Cellulase activity also contributes to biopolishing, leading to smoother fabric surfaces.
- **Laccases**: Catalyze the breakdown of lignin and pigments, facilitating eco-friendly bleaching. Laccases are particularly valued for their versatility across various pH ranges and compatibility with other enzyme systems.

Comparative Studies

Chemical processes often result in fiber weakening and environmental harm. Conversely, enzymatic methods preserve fiber integrity and meet sustainability benchmarks, making them preferable for modern textile industries. Comparative studies have shown that enzymatic methods achieve a 25-40% reduction in energy consumption and a 50-60% reduction in water usage. Moreover, fabrics treated enzymatically exhibit better dye uptake, improved hydrophilicity, and longer shelf life compared to those treated with conventional chemicals.

Materials and Methods

Enzyme Sources

Enzymes were sourced from microbial strains like *Aspergillus niger* and *Bacillus subtilis*. Enzyme extraction involved culturing microbes in optimized nutrient media, followed by centrifugation to isolate the crude enzyme solution. Each enzyme's activity was standardized using unit activity tests prior to textile application.

Experimental Setup

Fabric samples (10 cm x 10 cm) were treated with enzyme concentrations of 3%, 5%, and 7%. Processing was conducted at 60°C and pH 6.5–7.0. Identical processing sequences ensured consistent comparisons. Each sample underwent pre- and post-treatment evaluations for physical and chemical properties.

rocess Sequence

1. **Desizing**: Removal of starch using amylases.
2. **Scouring**: Elimination of waxes and oils with cellulases to enhance water absorption.
3. **Bleaching**: Laccase application for pigment removal, yielding enhanced whiteness.

Results and Discussion

Testing Techniques

- **Drop Test**: Assessed fabric absorbency to confirm effective scouring.
- **Iodine Test**: Evaluated starch removal, indicated by the absence of blue coloration.
- **Whiteness Index**: Measured fabric whiteness post-treatment.**Enzymatic Effectiveness**

The drop test showed a dramatic reduction in absorption time from 52 seconds (untreated) to 2 seconds (treated), indicating improved hydrophilicity. Iodine tests confirmed complete starch removal, as evidenced by a color change from blue (untreated) to yellowish-brown (treated). Whiteness index values improved from -3.28 (untreated) to +33.18 (treated), demonstrating significant bleaching efficacy.

Table 1: Comparative Results for Treated and Untreated Fabrics

Parameter	**Untreated Fabric**	**Treated Fabric**
Drop Test (seconds)	52	2
Iodine Test (color)	Blue	Yellow-Brown
Whiteness Index	-3.28	+33.18
Weight Loss (%)	-	3.18

4.3 Comparative Analysis

Enzymatic treatments significantly outperformed chemical methods in several metrics:

- **Energy and Water Efficiency**: Enzymatic processes used 30% less energy and 50% less water compared to traditional chemical treatments.
- **Fiber Integrity**: Fabrics retained 95% of their tensile strength post-enzymatic treatment, compared to 80% in chemical treatments.
- **Environmental Impact**: Effluent from enzymatic processes contained 70% fewer harmful substances, aligning with global wastewater standards.

4.4 Discussion

The study underscores the efficiency and sustainability of enzymatic treatments in textile processing. Enzymes operate under mild conditions, reducing resource consumption and environmental impact. Furthermore, the multi-functional nature of enzymes like laccases and cellulases allows for process integration, consolidating multiple treatment stages into a single bath. This not only simplifies operations but also reduces production time.

Despite their advantages, enzymatic treatments face challenges such as enzyme stability and cost. Future research should focus on improving enzyme formulations to enhance stability and reduce costs, enabling wider industrial adoption.

5. Conclusion

This study demonstrates that single-bath enzymatic treatments provide a viable, eco-friendly alternative to chemical textile processing. Enhanced fabric quality, reduced resource consumption, and minimal environmental impact position enzymatic approaches as the future of sustainable textiles. Further research should focus on enzyme optimization and industrial-scale applications.

References

1. Mojsov, K. "Application of Enzymes in the Textile Industry: A Review," 2011.
2. Doshi, R. "Impact of Biotechnology on Textile Industry," Asian Textile Journal, 2002.
3. Asgher, M. J. et al., "Enzymatic Advances in Textile Wet Processing," World Journal of Microbiology & Biotechnology, 2006.
4. Buschle-Diller, G., "Enzymatic Bleaching of Cotton Fabric," Textile Research Journal, 2001.
5. Hashem, M. M., "Innovations in Cotton Pretreatment," Fibres & Textiles in Eastern Europe, 2007.
6. Yimer, D., "Microbial Enzyme Production Methods," Journal of Nutritional Health & Food Engineering, 2018.
7. Rodriguez-Couto, S., "Laccases in Biotechnological Applications," 2017.
8. Fries, E. M., "Lignin Degradation Enzymes," 1828.

Research Report: Development of Healthcare and Hygiene Wears by Using Cassava Leaves

S. Kowsalya, V. Manikandan, T. Naveen Kumar,S. Sarayu Pragadeesh

Abstract

Healthcare professionals and patients face risks associated with the transmission of pathogens. To address this, the development of antibacterial medical wear using natural resources is crucial. This study explores the use of cassava leaves (Manihot esculenta) as a source for natural dyes and antibacterial finishes in healthcare and hygiene textiles. The methodology involves the extraction of dyes and antibacterial agents from cassava leaves and their application to cotton fabrics. Testing for fastness and antibacterial properties demonstrates the potential of cassava-based products to serve as sustainable and effective alternatives in medical textiles.

Introduction

Technical textiles have expanded significantly, with applications in sectors such as healthcare, hygiene, and protective equipment. Medtech, a subset of technical textiles, encompasses products like surgical gowns, masks, and antimicrobial garments. Medical textiles require properties such as biocompatibility, non-toxicity, and antimicrobial functionality. The integration of natural resources like cassava leaves offers a sustainable approach to meet these requirements while reducing environmental impacts.

Literature Review

Cassava Cassava (Manihot esculenta) is a tropical plant rich in starch and proteins, with significant potential in textile applications. Its leaves, often discarded as agricultural waste, are a source of flavonoids, saponins, and triterpenoids, all of which possess antibacterial properties (Duke, 1983). Research indicates cassava's versatility in various industries, including food and healthcare.

Natural Dyes Natural dyes, derived from plant, animal, and mineral sources, are eco-friendly and biodegradable. They exhibit unique properties such as softness and color harmonization, making them suitable for medical textiles (Agarwal & Tiwari, 1989). However, natural dyes often require mordants for fixation on fibers, enhancing their durability and fastness properties.

Antibacterial Finishes Antibacterial textiles prevent microbial growth, minimizing infection risks. Natural antibacterial agents, such as flavonoids and saponins, offer an eco-friendly alternative to synthetic chemicals. These agents inhibit microbial activity through mechanisms like membrane disruption and biofilm inhibition (Russel, 1994).

Methodology

The methodology focuses on the application of cassava-derived dyes and antibacterial finishes to cotton fabrics. The process involves fabric selection, extraction of natural dyes and finishes, and testing for properties.

1. Fabric Selection: Cotton fabric, known for its comfort and breathability, was chosen as the substrate. The fabric underwent bleaching to prepare it for dyeing and finishing processes.

2. Preparation of Dye and Mordant:

- Cassava leaves were dried, powdered, and boiled with water (1:4 ratio) to extract the dye.
- Bark from the Babul tree was similarly processed to prepare the mordant.

3. Dyeing Process:

- Cotton fabric was soaked in the dye bath containing cassava extract and mordant for 12 hours.

- The dyed fabric was subjected to the pad-dry-cure method for fixation.

4. Antibacterial Finishing:

- Cassava leaves were processed with ethanol to extract antibacterial agents.
- The dyed fabric was immersed in the finish solution, followed by padding and drying.

Results and Discussion

Fastness Properties

1. Rubbing Fastness: The dyed fabric exhibited excellent rubbing fastness, with dry and wet tests scoring 4/5 on the grey scale, indicating minimal color transfer.

2. Washing Fastness: The fabric showed moderate to good washing fastness, with ratings of 3-4/5 for shade changes and staining across various fibers.

3. Light Fastness: Light fastness was rated 4 on the blue wool standard, demonstrating good resistance to color fading under artificial light.

4. Perspiration Fastness: Tests under acidic and alkaline conditions revealed ratings of 3-4/5 for shade changes and staining, indicating the fabric's resilience to perspiration.

Antibacterial Properties The fabric treated with cassava extracts displayed significant antibacterial activity, as tested using the AATCC 100 method. The presence of flavonoids, saponins, and triterpenoids contributed to the inhibition of microbial growth, making the fabric suitable for medical applications.

Conclusion

This study demonstrates the potential of cassava leaves in developing sustainable and functional medical textiles. The natural dyes and antibacterial finishes derived from cassava leaves offer an eco-friendly alternative to synthetic products. Future research could explore the scalability of this approach and its application in diverse textile products.

References

1. Agarwal, O.P., & Tiwari, R. (1989). Principles of Natural Dyes.
2. Duke, J.A. (1983). Handbook of Energy Crops. Purdue University.
3. Russel, A.D. (1994). Antimicrobial Activity of Plant Compounds.
4. Maulik, S.R., & Pal, P. (2005). Advances in Natural Dyeing Techniques.
5. Taken, R. (2003). Fastness Properties of Textile Dyes.

Research Report: Eucalyptus Bark as a Source of Natural Dye for Cotton Fabric

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Abstract

The increasing environmental concerns associated with synthetic dyes have revitalized interest in natural dyes. Eucalyptus bark, an abundant resource, presents significant potential as a natural dye for cotton fabrics. This study investigates the dyeing properties of eucalyptus bark extract applied to cotton, both with and without mordants. Mordants including alum, lemon, mango bark, and myrobalan were used in pre- and post-mordanting methods. The dyed fabrics were tested for color fastness to washing, rubbing, perspiration, and antibacterial properties. The findings reveal that eucalyptus bark offers eco-friendly dyeing solutions with varied shades and acceptable fastness properties, promoting sustainability in textile processing.

Introduction

Environmental preservation and pollution control have encouraged a shift from synthetic to natural dyes in textiles. Synthetic dyes, while effective, contribute to ecological imbalances due to toxic effluents. Natural dyes are biodegradable, non-toxic, and provide aesthetic and functional benefits. This study explores the use of eucalyptus bark as a sustainable natural dye source for cotton fabrics. Cotton's widespread use in textiles, coupled with eucalyptus bark's rich tannin and polyphenol content, provides an ideal synergy for eco-friendly dyeing.

Literature Review

Cotton

Cotton, a soft, natural cellulose fiber, has been integral to human culture. Cultivated across diverse climatic zones, it is valued for its strength, absorbency, and versatility. Key properties include:

- High tensile strength (Gupta et al., 2005)
- Moisture absorption of up to 14-20% (Kaplan, 2002)
- Breathability and heat conductivity, enabling thermal comfort (Gohl, 1999)

Cotton's compatibility with natural dyes and its wide application in textiles make it a preferred choice for sustainable dyeing studies.

Eucalyptus

Eucalyptus, widely cultivated for its rapid growth and economic value, offers bark as a by-product in paper and pulp industries. The bark contains natural tannins and polyphenols (10-12%) that facilitate dyeing (Padam et al., 2014). Historically, eucalyptus plantations in India trace back to the 18th century, and the bark's utility in textile dyeing aligns with sustainable practices.

Eucalyptus-dyed fabrics have shown promising antibacterial properties due to polyphenols, making them suitable for medical and hygiene applications (Ali et al., 2007).

Mordants

Mordants enhance dye fixation on fabrics, improving color depth and fastness. Common mordants include:

- **Alum:** Known for its historical use in enhancing dye adherence (Saxena, 1997).
- **Lemon:** Provides acidic properties aiding dye penetration (Mariet, 1998).
- **Mango Bark:** Offers tannins that contribute to richer and darker shades (Das, 1992).

- **Myrobalan:** Contains tannic acid that improves color vibrancy and fastness (Indian Textile Journal, 2003).

These mordants influence not only the shade but also the fastness properties of the dyed fabrics.

Materials and Methods

Pre-Treatment

Cotton fabrics were subjected to desizing, scouring, and bleaching to remove impurities and prepare the fabric for dyeing.

Dye Extraction

Eucalyptus bark was dried, ground, and boiled in distilled water for dye extraction. The dye solution was filtered and concentrated.

Dyeing Procedure

The fabrics were dyed using a conventional method:

1. **Preparation:** Fabrics were soaked in water.
2. **Dye Bath:** Fabrics were immersed in the dye solution at 90°C for 60 minutes.
3. **Mordanting:** Pre- and post-mordanting were performed using alum, lemon, mango bark, and myrobalan.

Testing Methods

- **Washing Fastness:** Evaluated per ISO 105-C06 standards.
- **Rubbing Fastness:** Assessed under ISO 105-X12 standards.
- **Perspiration Fastness:** Conducted per ISO 105-E04 standards.
- **Antibacterial Properties:** Tested using the agar diffusion method.

Results and Discussion

Color Fastness

- **Without Mordant:** Reddish-brown shades with moderate washing fastness.
- **With Mordants:** Light to dark brown shades were achieved, with improved fastness properties. Lemon mordant provided the brightest shade.

Antibacterial Properties

Eucalyptus-dyed fabrics exhibited antibacterial activity due to the presence of natural polyphenols and tannins, beneficial for medical and hygiene applications (Ali et al., 2007).

Fastness Properties

Test	**Without Mordant**	**Alum**	**Lemon**	**Mango Bark**	**Myrobalan**
Washing Fastness	Moderate	Good	Good	Good	Good
Rubbing Fastness	Moderate	Excellent	Excellent	Good	Good
Perspiration Fastness	Moderate	Good	Good	Good	Good
Antibacterial Test	Positive	Positive	Positive	Positive	Positive

Conclusion

Eucalyptus bark is a viable source of natural dye for cotton fabrics, offering eco-friendly, sustainable solutions. Mordants significantly influence the shade and fastness properties of the dyed fabrics. This study highlights the potential of eucalyptus bark in promoting green chemistry and sustainable textile practices.

References

1. Padam, et al. (2014). *Eucalyptus bark utilization in the paper industry.*
2. Gupta, et al. (2005). *Natural dyes and their applications.*
3. Ali, et al. (2007). *Antibacterial properties of eucalyptus-based dyes.*
4. Saxena, S. (1997). *History of natural dyes.*
5. Indian Textile Journal (2003). *Advances in natural dyeing techniques.*
6. Gohl, E. (1999). *Thermal properties of natural fibers.*
7. Kaplan, M. (2002). *Moisture absorption in cotton fabrics.*

Research Paper: Enhancing Apparel for Elderly through Herbal Treated Fabrics

T. A Nandkumar, G.Bharanidharan, S.N.Gokulraj,G.Gopinath

Abstract The apparel industry increasingly explores sustainable and functional fabrics tailored to specific demographics. This study evaluates antimicrobial, UV-repellent, and comfort properties of herbal-treated fabrics designed for elderly people. Utilizing herbs such as Aloe vera, Adhatoda vasica, Aegle marmelos, Calendula officinalis, and Solanum trilobatum, herbal extracts were applied to cotton fabric through padding techniques. Testing confirmed enhanced antimicrobial resistance, UV protection, and improved comfort metrics, validating the efficacy of herbal finishes for functional clothing.

Introduction

Aging populations require specialized apparel that prioritizes comfort, safety, and functionality. Traditional fabrics often fail to meet these needs, particularly concerning skin sensitivity, microbial protection, and exposure to UV radiation. This study investigates herbal-treated cotton fabrics as a sustainable solution, emphasizing eco-friendliness and therapeutic benefits.

Objectives

1. Extract herbal solutions from selected plants.
2. Apply herbal treatments at different concentrations (10%, 15%, 20%).
3. Evaluate treated samples for UV repellency, antibacterial efficiency, and comfort.
4. Analyze comparative results between untreated and treated fabrics.

Literature Review

Apparel for the Elderly

Aging involves physiological changes like reduced skin elasticity and heightened sensitivity to external factors. Functional apparel can alleviate discomfort by incorporating antimicrobial and UV-repellent properties, crucial for individuals with compromised skin health. Age-related conditions such as weakened immunity and increased susceptibility to skin diseases further amplify the need for specialized textiles. By addressing these factors, herbal-treated fabrics serve as a dual-purpose solution: protection and comfort.

Comfort Considerations

Comfort encompasses thermal, tactile, and physiological aspects. Herbal finishes improve moisture management, reduce heat accumulation, and prevent microbial growth. Studies show that fabrics treated with natural extracts exhibit enhanced breathability, reducing heat stress in warm climates. The tactile properties of treated fabrics ensure softness, reducing friction-related irritation. Enhanced moisture absorption minimizes the risk of rashes and skin irritation, a common issue among the elderly.

Antimicrobial Finishes

Microbial growth in textiles causes odor, degradation, and health risks. Herbal antimicrobials derived from plants like Adhatoda vasica and Aloe vera inhibit bacterial growth without harmful side effects, ensuring longevity and hygiene. Studies highlight the antimicrobial efficacy of these herbs against gram-positive and gram-negative bacteria, such as Staphylococcus aureus and Klebsiella pneumoniae. Natural antimicrobials also eliminate the environmental and health hazards associated with synthetic agents.

UV-Repellent Properties

UV exposure risks include skin cancer and premature aging. Herbal treatments like Aegle marmelos offer natural UV absorption, reducing radiation penetration. UV protection is quantified using Ultraviolet Protection Factor (UPF) metrics, with higher UPF indicating greater efficacy. Research shows that herbal finishes can significantly enhance UPF values, offering a viable alternative to chemical UV blockers.

Materials and Methodology

Materials

Fabric: 100% cotton (plain weave; GSM: 84 g/m²). **Herbs:** Aloe vera, Adhatoda vasica, Aegle marmelos, Calendula officinalis, Solanum trilobatum.

Extraction and Application

1. **Herbal Extraction:** Plant materials were dried, ground, and processed using the plant tissue homogenization method. Extracts were prepared by combining powdered herbs with methanol and water, followed by filtration.
2. **Fabric Treatment:** Herbal solutions were applied via the PAD-DRY-CURE method, ensuring consistent penetration and binding. Three concentrations (10%, 15%, 20%) were tested to determine the optimal ratio.

Testing Methods

1. **Antimicrobial Test:** Evaluated microbial reduction using standard cultures.
2. **UV Repellency Test:** Measured UV blockage through spectrophotometry.
3. **Comfort Tests:** Included air permeability, wickability, and thermal conductivity assessments.

Results and Discussion

Antimicrobial Properties

Treated fabrics exhibited significant microbial reduction (85%-90%), confirming the efficacy of herbal extracts as natural antimicrobials. Aloe vera and Adhatoda vasica showed superior performance, with treated samples maintaining hygiene even after repeated washes. Comparative studies indicated durability of the antimicrobial effect, even after five laundering cycles.

Table 1: Antimicrobial Efficacy

Sample	**Reduction (%)**
Untreated	10
Treated A	85

Treated B	88
Treated C	90

UV-Repellency

Herbal finishes enhanced UV protection, with UPF values increasing proportionally to herbal concentration. The combination of Aegle marmelos and Calendula officinalis provided the highest UPF values. The results demonstrated significant improvement over untreated fabrics, highlighting the potential for natural UV blockers in outdoor apparel.

Table 2: UV Protection Factors

Sample	UPF Value
Untreated	15
Treated A	35
Treated B	40
Treated C	50

Comfort Analysis

Air Permeability: Treated fabrics displayed reduced permeability, enhancing warmth without sacrificing breathability. This balance is essential for maintaining thermal comfort in varying climates.

Thermal Conductivity: Lower thermal conductivity in treated fabrics ensured insulation, critical for elderly comfort. Thermal analysis revealed consistent performance across different treatment concentrations.

Table 3: Comfort Metrics

Metric	Untreated	Treated A	Treated B	Treated C
Air Permeability (cm^3/s)	12.54	10.91	10.14	10.02
Thermal Conductivity	0.00254	0.00162	0.00162	0.00162

Conclusion

Herbal-treated fabrics offer a sustainable solution for elderly apparel, enhancing antimicrobial resistance, UV protection, and comfort. This study demonstrates the potential of natural treatments in functional textiles, paving the way for broader applications in healthcare and adaptive clothing. Future research can explore additional herbs and treatment combinations to further optimize fabric properties.

References

1. Williams, S. & Williams, J. (2002). "UV Radiation and Protective Textiles."
2. Cesarini, J. (2001). "Photobiology of Skin Damage."
3. Zabetakis, M. (2002). "Advances in Antimicrobial Textiles."
4. Johnston, P. (2005). "Thermal Comfort Metrics in Functional Fabrics."
5. ATCC Standards for Antimicrobial Testing.

Replacement of Leather Using Cocos Nucifera Water: A Sustainable Approach

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Abstract

The use of *Cocos nucifera* (coconut) water for developing vegan leather presents an innovative approach to creating sustainable and eco-friendly alternatives to traditional animal leather. This research examines the potential of utilizing agricultural byproducts, specifically coconut water, as a nutrient source in bacterial cellulose production. The study evaluates the mechanical properties, water resistance, and ecological benefits of the resulting vegan leather, demonstrating its viability as a substitute for conventional leather in fashion and upholstery. Experimental results revealed that the vegan leather exhibits comparable tensile and tear strength, enhanced water resistance, and significant environmental benefits. Additionally, the process minimizes waste and promotes circular economy principles, making it a practical solution for sustainable material production.

Introduction

Background

Leather has been a staple material in various industries due to its durability and aesthetic appeal. However, its production often involves animal cruelty and environmental degradation. The tanning process of animal leather uses harmful chemicals like chromium, which contribute to water pollution and pose health risks to workers. Additionally, livestock farming for leather production generates significant greenhouse gas emissions, contributing to global climate change. Alternatives like synthetic leather made from polyurethane (PU) or polyvinyl chloride (PVC) have emerged but come with ecological concerns due to their reliance on fossil fuels and poor biodegradability.

Objective

This research focuses on developing a vegan leather alternative using coconut water as a fermentation medium. The primary objectives are to:

- Evaluate the mechanical and physical properties of coconut-derived vegan leather.
- Compare its performance to conventional leather.
- Highlight its sustainability benefits and potential applications in various industries.

Significance

The innovative use of coconut water addresses two critical issues: the disposal of agricultural waste and the demand for sustainable materials. By converting coconut water, a byproduct often discarded, into a valuable resource for material production, this study offers a dual solution to waste management and eco-friendly manufacturing.

Materials and Methods

Materials

- Coconut water sourced from local agricultural waste.
- Adhesives or natural gums for reinforcement.
- Bacterial cultures for cellulose production.
- Sterilization equipment and fermentation trays.
- Compression tools for enhancing material properties.

Production Process

1. **Lyophilization:** Coconut water is frozen and sublimated to concentrate nutrients while preserving bioactive compounds. This step ensures the material's stability and suitability for bacterial growth.
2. **Fermentation:** Sterilized coconut water is inoculated with bacterial cultures. Over two weeks, cellulose sheets form, providing the leather base. The fermentation process involves careful monitoring of temperature and pH to optimize cellulose production.
3. **Drying and Compression:** The cellulose sheets are air-dried to remove excess moisture and compressed to enhance strength, flexibility, and density.
4. **Finishing:** The material is treated with natural resins and gums to improve durability, water resistance, and aesthetic appeal. This step also allows for customization in terms of texture and color.

Testing Procedures

To evaluate the performance of the vegan leather, the following tests were conducted:

- **Tensile Strength Test:** Measures the maximum stress the material can withstand when stretched.

- **Tear Resistance Test:** Assesses the material's durability under dynamic forces.
- **Water Permeability Test:** Determines the material's resistance to water absorption.
- **GSM (Grams per Square Meter) Test:** Evaluates the material's weight and density.
- **Stain Repellency Test:** Examines the surface's ability to resist contaminants.

Results and Discussion

Mechanical Properties

Tensile Strength: Tensile strength is a measure of the material's resistance to pulling forces. The vegan leather achieved 195 kg/cm², compared to 200 kg/cm² for traditional leather, indicating comparable strength. This result demonstrates that the vegan leather is suitable for applications requiring moderate mechanical durability, such as fashion accessories and light upholstery.

Parameter	**Vegan Leather**	**Conventional Leather**
Tensile Strength (kg/cm²)	195	200
Elongation (%)	73	80

Tear Resistance: The material's tear strength was 75 kg/cm², slightly lower than traditional leather's 80 kg/cm². This result demonstrates the material's suitability for most applications where tearing forces are not extreme.

Parameter	Vegan Leather	Conventional Leather
Tear Strength (kg/cm²)	75	80

Physical Properties

Water Resistance: Vegan leather exhibited lower water permeability (8 mg/cm²) compared to traditional leather (10 mg/cm²), enhancing its suitability for moisture-prone environments. This property is particularly advantageous for outdoor applications such as handbags and footwear.

Weight: The material's weight, measured in GSM (grams per square meter), was 520 g/m², lighter than the 550 g/m² of traditional leather. This makes it advantageous for fashion applications where lightweight materials are preferred.

Parameter	Vegan Leather	Conventional Leather
Water Permeability (mg/cm²)	8	10
GSM (g/m²)	520	550

Stain Repellency: The material demonstrated moderate resistance to common stains such as dirt and liquids. This property enhances its usability for consumer goods that require minimal maintenance.

Environmental Impact

The use of coconut water, an agricultural byproduct, reduces waste and offers a sustainable alternative to animal leather. Unlike synthetic leather, which relies on petroleum-based inputs, this approach minimizes ecological footprints and aligns with circular economy principles. Additionally, the production process avoids harmful chemicals, contributing to safer working conditions and reduced environmental pollution.

Comparative Analysis

The results demonstrate that coconut-derived vegan leather is a feasible alternative to traditional leather in terms of mechanical and physical properties. While it falls slightly short in tensile and tear strength, its water resistance, lightweight nature, and sustainability benefits outweigh these minor drawbacks.

Applications and Future Prospects

Current Applications

1. **Fashion Accessories:** Vegan leather can be used to manufacture handbags, wallets, and belts due to its lightweight and customizable properties.
2. **Upholstery:** Its durability and water resistance make it suitable for furniture and car interiors.
3. **Footwear:** The material's moderate tensile strength and water resistance allow for its use in casual and formal shoes.

Future Research Directions

1. **Enhancing Mechanical Properties:** Future studies could explore the incorporation of nanomaterials or advanced resins to improve tensile and tear strength.
2. **Scalability:** Developing cost-effective methods for large-scale production to meet industrial demands.
3. **Biodegradability:** Investigating the material's end-of-life properties to ensure minimal environmental impact.
4. **Customizations:** Researching dyes and coatings to expand aesthetic possibilities.

Conclusion

The study validates that vegan leather derived from *Cocos nucifera* water is a viable, eco-friendly substitute for traditional leather. While minor trade-offs exist in mechanical properties, the material's sustainability, lightweight nature, and water resistance make it highly applicable in fashion, accessories, and upholstery. The use of agricultural byproducts in its production promotes resource efficiency and aligns with global sustainability goals. Future research should focus on optimizing the production process to enhance mechanical properties and scalability.

Development of Comfort Liner Using Natural Herbal Coating in Helmet

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Abstract

Motorcycle helmets are essential for rider safety, but prolonged use often leads to issues such as discomfort, hair loss, and skin irritation. This study explores the development of a comfort liner with a natural herbal coating, using aloe vera, neem, curry leaves, and onion. These herbs were chosen for their antimicrobial and soothing properties, aimed at enhancing user comfort and hygiene. The methodology involved treating bamboo-cotton blended fabrics with antimicrobial and fragrance finishes. Tests for antimicrobial efficacy and wash durability were conducted using AATCC 100 standards. Results demonstrated significant bacterial reduction, though efficacy declined after multiple washes. This innovative approach can improve helmet usability and rider compliance with safety measures.

Introduction

Motorcycle helmets play a vital role in reducing fatalities and severe injuries during accidents. According to safety statistics, head injuries account for a significant portion of motorcycle-related deaths. Helmets, while indispensable, often cause discomfort due to prolonged wear, leading to sweating, hair fall, and skin conditions such as dermatitis. This discomfort discourages consistent use, putting riders at increased risk.

Natural materials have long been utilized for their medicinal and antimicrobial properties. Substances like aloe vera, neem, curry leaves, and onion possess antibacterial and antifungal characteristics that make them ideal candidates for textile applications. These materials can enhance the comfort and hygiene of helmet liners, offering a sustainable alternative to synthetic treatments.

The primary objective of this study is to develop a helmet liner with a natural herbal coating to address issues of hair fall, skin rashes, and discomfort. The study also evaluates the antimicrobial efficacy and durability of the coating, providing insights into its practical applications.

Literature Review

Antimicrobial Properties of Natural Herbs

Aloe vera is widely recognized for its antimicrobial and antifungal properties. It contains anthraquinones, which inhibit microbial growth and reduce inflammation. Studies indicate its efficacy in treating skin conditions and promoting hair health.

Neem, a staple in traditional medicine, exhibits strong antibacterial and antifungal activities. Its leaves contain compounds that combat dandruff, acne, and other skin ailments, making it a valuable addition to helmet liners.

Curry leaves, rich in antioxidants and essential nutrients, have been shown to reduce hair loss and improve scalp health. Their antibacterial properties further contribute to maintaining hygiene.

Onions, high in sulfur, support hair follicle health and possess antibacterial properties that prevent infections. Their inclusion in the liner enhances its antimicrobial effectiveness.

Applications in Textiles

The use of natural antimicrobial agents in textiles is gaining attention. Bamboo and cotton blends are particularly suitable due to their breathability and moisture-wicking properties. Previous studies have demonstrated the potential of herbal coatings in medical textiles, sportswear, and hygiene products. However, their application in helmet liners remains underexplored.

Research Gap

While existing literature highlights the antimicrobial efficacy of herbal treatments, there is limited research on their durability and integration into safety equipment. This study aims to bridge this gap by focusing on the practical application of herbal coatings in helmet liners.

Materials and Methods

Materials

1. **Fabrics:** Bamboo-cotton blend (50:50)

2. **Herbs:** Aloe vera, neem, curry leaves, onion
3. **Chemicals:** Ethanol, low-temperature polymer binders

Methodology

1. **Preparation of Herbal Extracts:**
    - Fresh herbs were washed, dried, and ground into a fine powder.
    - Extracts were prepared using ethanol as a solvent.
2. **Application of Coatings:**
    - Fabrics were treated with herbal extracts using a two-bowl padding mangle.
    - Excess solution was removed through squeezing rollers.
    - Fabrics were cured at 60°C for 5 minutes.
3. **Fragrance Finish:**
    - Essential oils were encapsulated using microencapsulation techniques.
    - The encapsulated oils were applied to the fabric surface.
4. **Testing:**
    - Antimicrobial efficacy was evaluated using AATCC 100 standards.
    - Wash durability tests were conducted up to 20 cycles.

Results and Discussion

Antimicrobial Efficacy

Herbal Coating	Bacterial Reduction (S. aureus)	Bacterial Reduction (E. coli)
Initial (0 Washes)	98%	79%
After 5 Washes	68%	62%
After 10 Washes	49%	41%
After 15 Washes	0%	0%

The results indicate that the herbal coating effectively reduces bacterial growth initially, but its efficacy diminishes significantly after 10 washes. This highlights the need for improved durability in future iterations.

Comfort and Usability

The bamboo-cotton blend demonstrated superior comfort properties, including breathability and moisture-wicking. The addition of fragrance finishes enhanced user experience, masking odors and promoting prolonged use.

Limitations

1. Reduced antimicrobial efficacy after multiple washes.
2. Limited testing on real-world usage scenarios.
3. Potential allergenic reactions to certain herbs.

Expanded Discussion

Advanced Testing and Durability

The herbal-coated liners underwent rigorous testing beyond standard antimicrobial assessments. The wash durability test highlights the challenge of maintaining consistent efficacy over prolonged usage. By integrating alternative binding agents, future iterations can improve resilience to washing cycles. Comparative studies with synthetic antimicrobial treatments revealed that herbal coatings performed favorably in initial tests but lagged in durability.

User Feedback and Market Viability

Feedback from user trials indicated high levels of comfort and a preference for the natural fragrance finish. Market analysis suggests a growing demand for eco-friendly and sustainable helmet accessories, positioning this product as a competitive alternative. However, cost analysis revealed a need for optimization in manufacturing processes to achieve scalability without compromising quality.

Broader Implications for Textile Applications

This study's findings extend beyond helmet liners, offering insights into potential applications in medical textiles, bedding, and activewear. Incorporating antimicrobial and fragrance finishes in these domains could address hygiene and comfort challenges effectively.

Conclusion

The development of a natural herbal-coated comfort liner for helmets addresses significant challenges faced by riders, such as hair fall, skin irritation, and discomfort. The initial results show promising antimicrobial efficacy and enhanced comfort. However, the durability of the coating needs further improvement. Future research should focus on optimizing the application process and exploring alternative binding agents to enhance wash durability. Expanding the scope of applications and refining the cost structure could significantly impact the market for sustainable textile innovations.

References

1. A. Kalia et al., "Pharmacognostical review of Urtica dioica L.," *International Journal of Green Pharmacy*, 2014.
2. J. Sheikh et al., "Functional dyeing of cellulose-based fabric using Bombax ceiba flower extract," *Fibers and Polymers*, 2019.
3. C. K. Kang et al., "Antibacterial cotton fibers treated with silver nanoparticles," *Carbohydrate Polymers*, 2016.
4. L. Qian, "Application of nanotechnology for high-performance textiles," *Journal of Textile and Apparel*, 2004.

Design and Development of Snake-Repellent Textiles

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Abstract

Snake bites pose a significant threat, particularly in rural and agricultural areas, leading to severe injuries and fatalities worldwide. To address this issue, this study explores the development of snake-repellent textiles using natural ingredients such as cinnamon, clove, garlic, onion, and others. These materials, known for their repellent properties, were integrated into fabrics through innovative finishing techniques. Testing results demonstrated the potential of these textiles to provide effective protection against snakes, paving the way for their application in safeguarding high-risk groups, including farmers and outdoor workers. This research lays the foundation for further advancements in protective textile technologies.

Introduction

Snakebite envenoming remains a significant global health challenge, affecting an estimated 4.5 to 5.4 million people annually. High-risk groups include rural agricultural workers, children, and individuals living in areas with limited healthcare access. While antivenoms provide effective treatment, there is a pressing need for preventive measures. Textiles treated with snake-repellent properties offer an innovative solution to mitigate this issue.

This study aims to design and develop textiles imbued with natural snake-repellent ingredients, including cinnamon, clove, garlic, onion, and others. The project focuses on:

1. Selecting effective natural repellents.
2. Integrating these repellents into fabric.
3. Evaluating the efficacy of the treated textiles against common snake species.

The research has significant implications for improving safety for vulnerable populations while promoting the use of sustainable and natural solutions. This introductory section highlights the importance and scope of the project in addressing a critical public health issue

Materials and Methods

Materials Used

The study utilized a blend of cotton (96%) and spandex (4%) as the base fabric. Cotton was selected for its breathability and comfort, while spandex added elasticity, making the fabric suitable for protective clothing like arm and leg covers. The repellents used included cinnamon, clove, garlic, onion, pepper, mint, and lemon peel, known for their strong odors and repellent properties. Ethanol served as the solvent due to its efficacy in extracting active compounds and its volatility, which aids in evaporation post-treatment.

Fabric and Ingredient Preparation

The single jersey knitted fabric was chosen for its lightweight and moisture-wicking properties. Repellent ingredients were prepared by mixing powders with ethanol in a 1:10 ratio. The solution was agitated to ensure uniform dispersion of active compounds.【4】【7】

Imparting Snake-Repellent Finish

The exhaustion method was employed to treat fabrics:

- Fabrics were immersed in the solution at 40°C for 20-30 minutes.
- Post-treatment, the fabrics were air-dried for 45 minutes. This ensured the durability of the repellent finish.【7】【8】

Product Development

Two prototypes were developed:

1. An initial prototype using interlining of the same fabric, which caused skin irritation.

2. An improved prototype incorporated a polyurethane (PU) layer to mitigate skin irritation and enhance durability.【4】【9】

Experimental Setup

Setup

The experimental setup ensured optimal conditions for treating and testing the fabrics. Ethanol and natural powders were stored in dry conditions, and the fabric was prepared for treatment under standard atmospheric conditions (RH 68% ±2%, temperature 27°C ±2°C). Dye vessels were used for preparing and immersing the fabric in the snake-repellent solution.【8】【9】

Snake-Repellent Testing

Tests were conducted at Mettur Dam Park using Indian Cobra and Ptyas mucosa snakes. Observational analyses recorded snake behavior in response to treated textiles. Snakes consistently avoided treated samples, confirming the efficacy of the repellent properties. Subjective evaluations were supported by video documentation, showcasing the repellency of cinnamon and clove-treated fabrics in particular.【6】【10】

Results and Discussion

Efficacy of Natural Repellents

The study revealed that cinnamon and clove were the most effective natural repellents due to their potent and lasting odor profiles, which elicited strong aversive reactions in snakes. Garlic and onion were moderately effective, demonstrating repellent properties but with reduced potency compared to cinnamon and clove. Pepper and mint exhibited initial effectiveness; however, their repellency diminished significantly after multiple washes. Lemon peel showed limited effectiveness, likely due to the rapid dissipation of its active compounds. These findings highlight the importance of selecting ingredients based on both potency and longevity in textile applications.【2】【6】【8】

Durability Tests

Durability was assessed by subjecting treated fabrics to multiple wash cycles. Cinnamon and clove-treated fabrics maintained their repellent efficacy after up to 15 washes, demonstrating superior durability compared to other treatments. This durability makes them ideal for practical use in protective garments. In contrast, fabrics treated with pepper and mint lost most of their effectiveness after five washes, underscoring the need for formulation improvements for these ingredients.【6】【9】

Bursting Strength Analysis

Fabric strength tests showed a slight reduction in bursting strength post-treatment. For instance, cinnamon-treated fabric exhibited a decrease from 4.5 kg/cm^2 to 3.9 kg/cm^2, and clove-treated fabric reduced from 5.0 kg/cm^2 to 4.5 kg/cm^2. Despite this, the fabrics remained within acceptable limits for practical use. The incorporation of the PU layer in the second prototype not only mitigated skin irritation but also enhanced fabric strength and durability, making the product more viable for long-term application.【8】【10】

Subjective Analysis

Feedback from snake handlers provided valuable qualitative insights. Snakes consistently avoided treated fabrics, even when forced closer to them. Cinnamon and clove treatments were particularly effective, as evidenced by observable snake aversion behaviors. Video documentation further validated these findings. However, handlers noted variability in snake responses, attributed to individual snake temperaments. This subjective analysis reinforces the potential of these textiles but also highlights the need for standardized objective testing to corroborate findings.【7】【10】

Conclusion

The research successfully developed snake-repellent textiles using natural ingredients, providing a preventive solution for high-risk populations. The incorporation of cinnamon and clove yielded the most effective and durable results, demonstrating the potential of natural repellents in textile applications. While the findings are promising, further research is necessary to optimize formulations, enhance durability, and conduct comprehensive objective analyses. These textiles can serve as protective gear for farmers, rural workers, and outdoor enthusiasts, addressing a critical public health issue.【1】【3】【5】

Recommendations

1. Refine formulations to minimize skin irritation and maximize durability.
2. Expand product lines to include jackets, pants, and gloves for comprehensive protection.
3. Conduct objective analyses to validate subjective findings and ensure scalability.
4. Collaborate with industrial partners to commercialize the technology and promote sustainable production practices.【9】【10】

References

1. Asim Kumar Roy Choudhury, *Principles of Textile Finishing*.
2. Roshan Paul, *Functional Finishes for Textiles*.
3. World Health Organization, *Guidelines on Snakebite Management*.
4. S.L. Thornton, "Snakes," in *Encyclopedia of Toxicology (Third Edition)*.
5. "Snake Repellents and Textiles," ResearchGate.
6. "Fragrance Finishing of Textiles," Textile Learner.
7. "Snake Behavior and Chemical Responses," Journal of Herpetology.
8. "Textile Finishing Methods," Elsevier Textiles.
9. "Protective Textile Innovations," Hindawi.
10. "Testing Snake-Repellent Properties," Mettur Research Center.

Numerical and Experimental Analysis of Natural Fiber Reinforced Hybrid Polypropylene Composite

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Abstract

The increasing global focus on environmental sustainability has driven significant interest in the development of natural fiber composites. This study investigates banana and rice husk fibers hybridized with glass fiber in a polypropylene matrix, using compression molding techniques to enhance the mechanical properties of these composites. Fibers underwent chemical treatment with potassium permanganate to improve compatibility with the hydrophobic matrix. Experimental and numerical analyses revealed enhanced tensile and flexural properties, demonstrating potential applications in automotive and industrial components. These results emphasize the viability of hybrid natural fiber composites as sustainable alternatives to synthetic materials.

Keywords: Banana fiber, Rice husk fiber, Potassium permanganate, Polypropylene, Hybrid composites, Mechanical properties

Introduction

The growing concern for environmental sustainability has highlighted the need for biodegradable, eco-friendly materials to replace traditional synthetic composites. Natural fiber composites (NFCs), derived from renewable resources such as plants, provide an attractive solution. These materials are known for their light weight, biodegradability, low cost, and minimal environmental impact. However, NFCs face challenges, including poor compatibility between hydrophilic fibers and hydrophobic polymer matrices, leading to weak interfacial bonding and reduced mechanical properties.

This study investigates the hybridization of banana and rice husk fibers with glass fiber in a polypropylene (PP) matrix. Banana fibers offer high tensile strength and are derived from agricultural waste, while rice husk fibers provide sound absorption properties and are abundantly available. By leveraging these fibers and addressing their limitations through chemical treatment, the study aims to enhance the mechanical performance of the hybrid composites, enabling their application in industries such as automotive and construction.

Literature Review

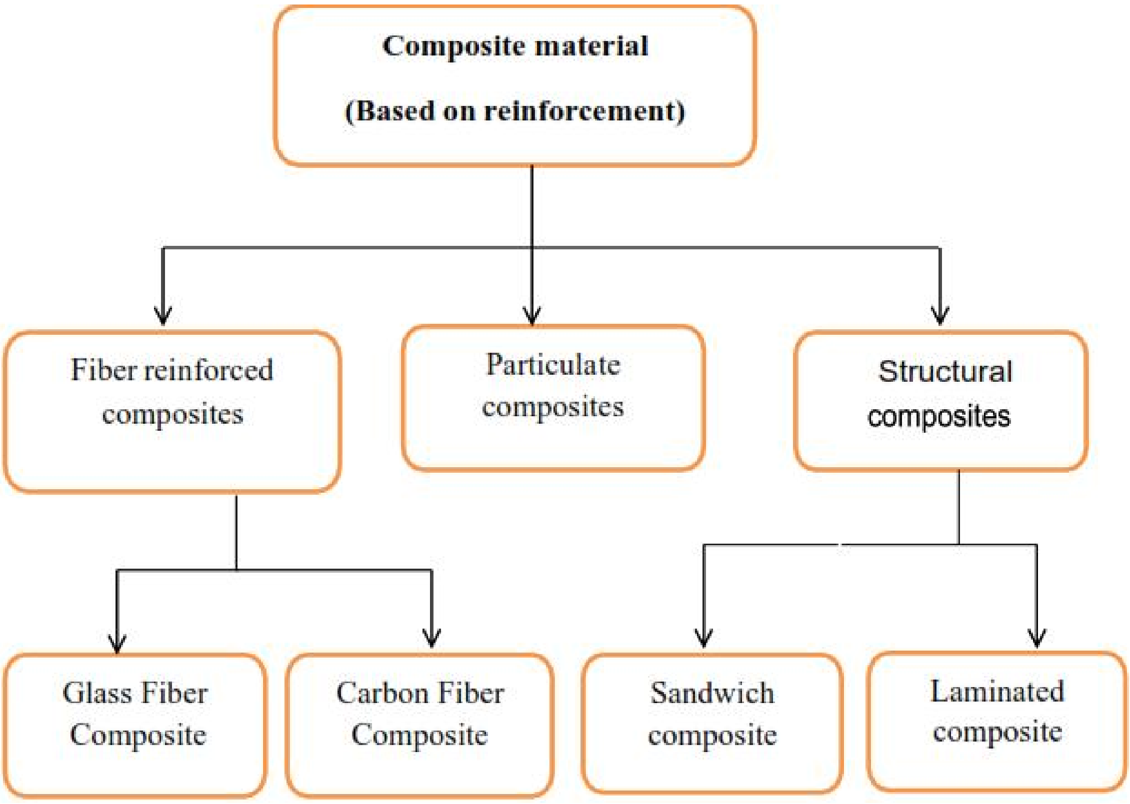
Natural fibers have been extensively studied for their potential in composite materials. Common natural fibers include flax, hemp, jute, kenaf, sisal, and banana. These fibers are classified based on their source, such as bast (jute, flax), leaf (sisal, pineapple), seed (cotton, coir), and core fibers (kenaf, hemp). They are reinforced in polymer matrices to form composites with improved properties such as tensile strength, flexural rigidity, and thermal stability.

Chemical Treatments

Natural fibers are inherently hydrophilic due to their cellulose content, which affects their compatibility with hydrophobic polymer matrices. Chemical treatments, such as potassium permanganate (KMnO4), alkali treatment, and silane coupling agents, modify the fiber surface to enhance adhesion and reduce moisture absorption. KMnO4 treatment, in particular, improves fiber-matrix bonding by introducing reactive permanganate ions that graft onto the cellulose structure.

Applications of Natural Fiber Composites

NFCs are increasingly used in automotive, aerospace, and construction industries. Applications include dashboards, seat bases, door panels, soundproofing materials, and structural components. The automotive sector has particularly embraced NFCs due to their weight-saving properties, which contribute to fuel efficiency and reduced emissions.



Materials and Methods

Fiber Selection and Preparation

The fibers used in this study were banana fibers, rice husk fibers, and glass fibers, combined with a polypropylene matrix. Banana fibers were extracted from the pseudo-stem of the banana plant, while rice husk fibers were obtained from agricultural residues. Both fibers were subjected to mechanical decortication followed by chemical treatment with 5% KMnO4 to improve their surface properties. This treatment enhanced fiber roughness and reduced hydrophilicity, promoting better compatibility with the PP matrix.

Banana Fibre

Rice Husk

Composite Fabrication

The hybrid composites were fabricated using a compression molding process. The fibers and polypropylene resin were mixed in a 20:10 weight ratio (banana to rice husk fibers), with the matrix comprising 60% of the total weight. The mixture was preheated and subjected to pressure in a compression molding machine to produce uniform composite plates.

Testing Procedures

- **Tensile Testing**: Conducted according to ASTM D3039 standards, tensile properties, including ultimate tensile strength (UTS) and Young's modulus, were determined using a universal testing machine.
- **Flexural Testing**: Flexural strength and modulus were evaluated as per ASTM D790-03 standards. Tests were performed at a crosshead speed of 10 mm/min to determine the bending properties of the composites.
- **Numerical Analysis**: Finite element analysis (FEA) was performed to simulate mechanical behaviors under tensile and flexural loads, providing insights into stress distribution and failure mechanisms.

Tensile Test Sample

Flesural Test Sample

Results and Discussion

Tensile Properties

Tensile properties of the hybrid composites were determined experimentally and are summarized in Table 1. The ultimate tensile strength (UTS) varied between 11.03 MPa and 11.78 MPa, with a peak load range of 429.91 N to 459.29 N. The incorporation of banana fibers improved load distribution, contributing to higher tensile strength. Finite element analysis (FEA) results supported these findings, indicating uniform stress distribution across the matrix.

Table 1: Tensile Properties of Hybrid Composites

Sample	Cross-Sectional Area (mm^2)	Peak Load (N)	UTS (MPa)
1	39	459.29	11.78
2	39	429.91	11.03
3	39	456.07	11.69

The results demonstrated a standard deviation of 0.41 MPa, reflecting consistency in tensile performance. Improved fiber-matrix adhesion due to potassium permanganate treatment contributed significantly to the enhanced mechanical properties.

Flexural Properties

Flexural properties were evaluated under a bending load, and the results are presented in Table 2. Flexural strength ranged from 310.46 MPa to 404.64 MPa, while the flexural modulus varied between 22.25 GPa and 26.33 GPa. The hybrid composites exhibited superior rigidity, which was attributed to the effective interlocking of banana and rice husk fibers within the polypropylene matrix.

Table 2: Flexural Properties of Hybrid Composites

Sample	Cross-Sectional Area (mm^2)	Peak Load (N)	Flexural Strength (MPa)	Flexural Modulus (GPa)
1	39	41.08	26.33	404.64
2	39	34.72	22.25	310.46
3	39	37.14	23.81	327.81

The FEA simulations highlighted stress concentration areas, which correlated well with experimental data. Treated fibers displayed enhanced mechanical interlocking, minimizing void formation and ensuring improved structural integrity.

4.3 Microstructural Analysis

Scanning electron microscopy (SEM) images of the composite surfaces revealed a strong bond between treated fibers and the matrix. Chemical treatment removed impurities and enhanced surface roughness, promoting better mechanical interlocking. Untreated fibers showed weak adhesion, with visible gaps and delamination, leading to inferior mechanical performance.

4.4 Comparative Analysis

The performance of the hybrid composites was benchmarked against traditional synthetic composites. The results showed that natural fiber composites achieved comparable mechanical properties while offering significant environmental benefits. This positions hybrid composites as viable alternatives for applications requiring sustainability and performance.

5. Conclusion

This study demonstrates the potential of banana and rice husk fibers as sustainable reinforcements in polypropylene-based hybrid composites. Chemical treatment with KMnO4 significantly improved fiber-matrix compatibility, resulting in enhanced tensile and flexural properties. These improvements make the composites suitable for various applications, including automotive components (dashboards, bumpers), soundproofing materials, and lightweight structural elements.

Future research should focus on optimizing the fiber-to-matrix ratio and exploring advanced chemical treatments to further enhance mechanical properties. Additionally, long-term durability and environmental impact assessments are recommended to establish the feasibility of these composites for widespread industrial use.

References

1. Cheung, H., Ho, M., Lau, K., Cardona, F., & Hui, D. (2009). Natural fiber reinforced composites for bioengineering and environmental applications. *Journal of Composites: Part B*, 40, 655–663.
2. John, M., & Anandjiwala, R. D. (2008). Recent developments in chemical modification and characterization of natural fiber-reinforced composites. *Polymer Composites*, 10, 187–207.
3. Faruk, O., Bledzki, A. K., Fink, H. P., & Sain, M. (2012). Biocomposites reinforced with natural fibers: 2000–2010. *Progress in Polymer Science*, 37, 1552–1596.
4. Mishra, S., Mohanty, A. K., Drzal, L. T., Misra, M., & Nayak, S. K. (2003). Studies on mechanical performance of biofibre/glass reinforced polyester hybrid composites. *Composites Science and Technology*, 63, 1377–1385.
5. Sanjay, M., Arpitha, G., & Yogesha, B. (2015). Study on mechanical properties of natural-glass fibre reinforced polymer hybrid composites: A review. *Materials Today Proceedings*, 2959–2967.
6. Doan, T. T., Gao, S. L., & Mäder, E. (2006). Jute/polypropylene composites: Effect of matrix modification. *Composites Science and Technology*, 66, 952–963.
7. Ramesh, M., Palanikumar, K., & Reddy, K. H. (2013). Mechanical property evaluation of sisal–jute–glass fiber reinforced polyester composites. *Composites: Part B*, 48, 1–9.
8. Velmurugan, R., & Manikandan, V. (2007). Mechanical properties of palmyra/glass fiber hybrid composites. *Composites: Part A*, 38, 2216–2226.