Assessing the Functional Properties of Cotton Fabric Treated with *Geranium* Extract

By

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Certified as Bonafied Research work

30/5/22
Signature of Head of the Department

30.05.22
Signature of the Supervisor

CERTIFICATE FROM THE SUPERVISOR

I certify that dissertation entitled **"Assessing the Functional Properties of Cotton Fabric Treated with Geranium Extract"** submitted for the degree of Master of Science (M.Sc.,) Textiles and Fashion Apparel by **Lydia Dharsini S** is the record of project work carried out by her during the academic year 2021 to 2022 under my guidance and supervision and this work has not formed the basis for the award of any Degree, Diploma, Associate ship, Fellowship, Titles in this University or any other similar institution of higher learning.

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Head of the Department

30.05.22

Signature of the Supervisor with Designation

DECLARATION

I declare that the dissertation entitled **"Assessing the Functional Properties of Cotton Fabric Treated with Geranium Extract"** submitted by me for the degree of Master of science (M.Sc.,) is the record of work carried out by me during the period from 2021 to 2022 under the guidance of **Dr. G. Bagyalakshmi,** M.Sc., M.Phil., Ph.D. (Avinashilingam), Associate Professor (SG), Department of Textiles and Clothing, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore-642 043 and has not formed the basis for the award of any Degree, Diploma, Associate ship, Fellowship, Titles in this University or any other similar institution of higher learning.

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1. INTRODUCTION

The most common way of producing antimosquito textiles was through addition of anti-insect agents into spinning step, making insect repellent fibers with more permanent effects. Spraying, dipping, and pad-dry-cure methods are also used to impart insect-repellent properties into textiles. Impregnating the fabrics into insect-repellent finishing agents along with use of a binder has been done for enhancing the durability of the finish, (Anuar and Yusof, 2016). Mosquito repellent textiles is one of the revolutionary ways to advance the textile field by providing the much-needed features of driving away mosquitoes, especially in the tropical areas. Mosquito bites can give an unpleasant feeling and may transmit the vector disease such as dengue or malaria to humankind. Mosquito are attracted to human blood containing protein to develop their eggs, biting human to another human, thereby transmitting the vector disease to human. Mosquito repellent textile is one of the revolutionary method in the advancement of the textile field. These extracts can be used as textile finishing agents in the crude form or as microcapsules or emulsions to enhance the durability of the extracts, (Banupriya and Maheshwari 2013). A natural insect repellent is effective and they also contain antibacterial, antiseptic, anti-inflammatory, and anti-fungal properties.

Finishes are used in the final part of the construction or manufacturing process, forming the final surface of an element. Functional finishes that address comfort and protection have become increasingly important in recent years. Finishes that improve the protective functions of clothing are important to individuals who work or participate in other activities where hazards may be encountered. Flame resistance, liquid barrier, antimicrobial and UV protective finishes are some of the functional finishes. Phase Change Materials (PCMs) and Nanotechnology are some of the newest approaches to providing ‘smart’ finishes impacting comfort and protection, (R.M. Cloud,2013). Functional finishes improve the performance properties of the fabric such as durability and strength. Property-changing functional finishes provide the added qualities desired for a particular fabric or they may be used to change an undesirable property to a more desirable one. Many such finishes add more than one property to a fabric Examples of functional finishes are, crease resistant/durable press, flame retardant, shrinkage control, sanforizing, soil-release, water-proof and water-repellent, antistatic, antimicrobial,(Choudhury,2013).

Textile finishing processes can be applied in different material forms fiber, yarn, fabric etc., the most common is fabric finishing. General expectations for all these finishing are having homogenous effect, non-damaged fibers, non-broken fabric, repeatable and economical process, low environmental impact and reduced energy and water consumption. Different application techniques are used and related to give desired properties to textile materials. Most of these application techniques are wet processes. These wet processes include exhaustion, impregnation, vacuum application, maximum application techniques as well as spraying, coating, transfer and foam application methods which are among the low-liquor application techniques. In addition to these methods, microencapsulation, plasma application, sol–gel technology and lamination techniques, which have become increasingly important in recent years, are also included in finishing applications,(Basyigit, 2021)

Eco-friendly finishes refer to suitable textile processing methods that deliver not only eco friendly finished products but also does not hamper the surrounding atmosphere and environment by polluting the air and water respectively, due to emissions of harmful gases and effluent water discharges. Environmental considerations are now becoming vital factors during the selection of consumer goods including textiles all over the world. However due to increased awareness of the polluting nature of textiles effluents, social pressures are increasing on textile processing units. The possibility of finishing textiles from medicinal plant extracts from material like Basil leaves, Neem, turmeric, sandalwood, etc. These extracts are a pure form of eco-friendly material and had a successful application on textiles. The various other finishing techniques that are termed as “Environment Friendly”,(Khodary, et.al., 2017).

The large extent of plant products such as roots, stem, seeds, flowers, fruits, leaves has been investigated for mosquito repellent properties to be applied to the textiles. Plant extracts such as eucalyptus oil, rosemary oil, and clove oil are recognized for mosquito repellence. Essential oils are extracted from plants which are complex mixtures of volatile organic compounds.Many essential oils have the repellence property with the existence of lower isoprenoids.Natural essential oils such as lemongrass, citronellal grass, lemon eucalyptus oil, eucalyptus oil, peppermint, neem, thyme oil, lavender, holy basil are few products which possess mosquito repellent property. Essential oils such as eucalyptus, Lawsonia inermis leaf extract, Cryptomeria japonica, Nerium oleander L flower extract showed great larvicidal activity against mosquito larvae. Azadiractin, a chemical compound

that is present in the seed of the neem tree had been identified for mosquito larvicidal activity.

Pelargonium zonale is a species of Pelargonium native to Southern Africa in the western regions of the Cape Provinces, in the geranium family. It is one of the biggest of the widely cultivated plant Pelargonium and hortorum, often called "geranium", "zonal geranium" or "zonal pelargonium". Plants are upright and bushy with succulent stems and offer clusters of single or double flowers in red, salmon, pink or white. The fragrance is similar to lemon and the flowers have a strong smell that keeps the pests away .

Considering the above facts the investigator selected the research work on the topic **"Assessing the Functional Properties of Cotton Fabric Treated with *Geranium* Extract"** with the following objectives.

- To carry out natural extraction from pelargonium zonale.
- To finish the cotton fabric with the selected plant extract.
- To analyze the functional properties such as mosquito repellency, antimicrobial activity and UPF analysis.
- To evaluate the properties and SEM appearance of the finished cotton fabric.

2. REVIEW OF LITERATURE

The review of literature pertaining to the study **"Assessing the Functional Properties of Cotton Fabric Treated with Geranium Extract"** consists of the following headlines.

2.1 Cotton

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- 2.1.2 Importance of cotton
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2.4 *Pelargonium zonale* (GERANIACEAE)

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- 2.4.2 Uses of geranium leaf
- 2.4.3 Chemical constituents

2.1 Cotton

Cotton the king of fibre is the most widely used fibre in the world, with a long and fascinating history. It was introduced by Arab traders. The word "cotton" comes from qutun, the Arabic name. Its usage increased widely in the 17th century as trade with India increased,(Khalje,1999). It has played a vital role in the history of mankind and cultivation due to its importance in agriculture as well as industrial economy. It is also called as "White Gold," (Gutierrez et.al., 2017).

Cotton is vegetable fibre of the genus Gossypium, a member of the Malvaceae, or mallow, family and the first cousin of the Hibiscus Rosa Sinensis. Wild cotton grows in tropical and subtropical regions of the united states, Mexico, South America, Africa, the Arabian peninsula, India, Australia, New Guinea and Hawaii,(Britton,1992). There have been a number of developments in quality of cotton fibres produced around the world, (Goswamin et al.,2004).People demand cotton because of the quality, products clothing made from cotton absorbs moisture and is easily dyed different colours. Cotton clothing is also lightweight, cool to wear, and affordable, (Monteiro et al., 2006).

2.1.1 History of Cotton

The origin of cotton is lost in legend for it is older than the recorded history. Probably it originated in India for it is mentioned in 'Rig Veda' written nearly 3,500 years ago. The actual woven cotton fabric was found in an excavation of Mohenjodaro, which is dated back to third century BC. The word cotton is derived from 'Quton' which means a plant found in a conquered land. Perhaps cotton was being in areas which were invaded by the arbas,(Sekhri,2012).

Scientists found bits of cotton bolls in caves of Mexico and pieces of cotton cloth that proved to be at least 7,000years old. Cotton is the most prevalent fibre in the world and it is renowned for its breathability, strength and versality. Cotton has helped to shape the history of the world by clothing and protecting countless civilizations.
(http://nyfashioncenterfabrics.com/cotton-fabric-info.html)

The first record of cotton in English trade is by Hakluyt in the late fifteenth century, who mentions Genoese cotton imports by 1600. Then it was imported from Antwerp, Sicily the levant and Lisbon,(Roche,1996). The oldest known cotton yarn was produced in Mohenjodaro in Pakistan 3000 years ago. The strong and fineness facilitate the weaving of delicate, lossely woven fabrics such as muslin which originally came from Mousul in Iraq,

(Gillow et al., 1999). Cotton fibers of ancient or modern are flattened twisted tubes, the walls of which are composed of fibrites of cellulose built up in a number of concentric layers. The textile character known to scientist and the trade as “cotton like” is the result of this constsnt fibrous structure,(Trocme et al.,2002). Cotton , the white gold, is the most precious gift of nature to cloth the people all over the world, (Mahalingam ,2006).

2.1.2 Importance of Cotton

Cotton is well-known cellulosic fibre with a utilization history dating back to ancient times. Cotton is still the most important natural textile fiber, because of its numerous advantages, such as being hypoallergenic, having good air permeability, having a good ability to absorb body moisture and being generally comfortable to wear, (Stefanovic, et al., 2014). India presently accounts for about 15 percent of the world cotton crop and is the third largest producer in the world after china and USA. India’s cotton average of about 9.0 million hectares is the highest in the world. In 2004, cotton met 52 percent of the worldwide demand for apparel fiber. Cotton is an important cash crop in more than 80 countries, (Kadolph, 2009). Cotton is grown in more than 100 countries and it accounts for about 2.5 percent of the world's land, making it one of the most significant in terms of land use after food grain and soy beans, (Gordon et al., 2007). Today, the world uses cotton more than any other fibre. At the farm level alone, the production of each gear's crops involves the purchase of more than $5.3billion worth of supplies and services, (Thomas, 2006).

Some cotton cellulose is non-crystalline or amorphous in the sense of "lacking definite crystalline form". One reason is that cotton cellulose has a broad molecular weight distribution making high-crystalline perfection impossible, (Lecoin, 2007). Cotton is inherently a replica of nature. In a blind test, one can easily identify the surface of the fibre by touching or handling the fibrous assembly. More interestingly, touching and feeling of cotton fibres result in an instantaneous acquaintance and comfortable bonding, much like touching soft human skin, (Gupta, 2005). The seed hair of the cotton plant is separated from the seeds by the process of ginning and then passes into commerce as raw cotton, (Beech, 2010). It is strong and reasonably low price. The fibre is short and fine, usually about one inch long. Cotton is called a dead fibre because it has little luster, wrinkle resistance and elasticity. Cotton is by far the most commonly used textile fibre, (Board, 2003).

Cotton is a pure cellulosic fibre grows in the seed hair pod (ball) of the cotton plant grown and cultivated in warm climates, (Needle, 2011). Native cotton is the purest form of natural cellulose. However, it contains usual constituents of a vegetable cell. The contents are

proteins, oil and wax, pectose and pectins, mineral matters and natural colouring matters, (Mishra, 2005).

2.1.3Properties of Cotton

The length of the cotton fibre varies from 3/8 to 21/2 inches. The length is 1-3 thousand times its diameter. The colour of raw cotton varies from white to yellow and grey. The fibres are fairly dull inherently on being mercerized. The cross section becomes more regular, thus increasing their luster. Cotton has moderate strength ranging between 3.0 and 5.Og/d. When wet, its strength increases by about 20 percent elongation and resiliency 3-7 percent elongation at break. Elastic recovery is poor and resiliency is low, thus making the fabric prone to wrinkling. Density is 1.54g/cm2. Moisture regain is 8.5 percent. Mercerized cotton has a moisture regain of 10.3 percent. Cotton is flammable i.e., it ignites quickly burns freely and has an afterglow. Its odour while burning similar to burning paper. The residue obtained is a fluffy grey ash. Safe ironing temperature for cotton is 200°C, at temperature greater than 250°C rapid deterioration can occur. Cotton is not resistant to acid but however hot dilute and strong acids cause fibre disintegration. Chlorine bleaches can remove stains on cotton using the conditions. Cotton is highly resistant to organic solvents and thus can be easily dry cleaned. Silver fish attacks starched cotton fabric. Moths and carpets beetle which eat up protein fibres do not attack cotton (Cellulose) fibres. Bacteria and fungi in soil can also degrade cotton, (Sekhri, 2012).

"Absorbent" cotton will retain 24-27 times its own weight in water and is stronger when wet than dry. The fabric absorbs and release perspiration quickly, thus allowing the fabric to "breath", (Claud, 2006). The quality of cotton is measured partly by the length and brightness of the fibre. This depends on the species, quality of the seed and soil, the mode of cultivation and climatic conditions, (Dantyagi, 2004). Cotton fabric can also wrinkle, but the fabric is highly resilient and will not tear easily if creased frequently. Both linen and cotton fabrics can be sterilized by boiling in hot water without damaging the fibre. The principal use of cotton fabric is to make textile products for clothing. (Singh, 2010). Each cotton fibre is a very interesting mass of cellulose formed by the interplay of natural forces so diverse that the physical form of each fibre differs subtly from that of its neighbors in the same cotton ball (Hall, 2004).

Cotton fibre may be spun alone or blended with other fibers in making yarns. Cotton yarns are also combining or mixed with other yarns in making fabric. These techniques contribute to fabric such desirable cotton properties as softness, strength, absorbency and

affinity for colour, (Singh, 2004). Physical characteristics of purified bleached cotton is nearly pure cellulose. It resists the action of alkalis well, but is harmed by hot, strong acids, or if acid is allowed to dry on the fabric. It is not armed by high temperature and so may be ironed with hot iron, (Watson, 2008). Mechanical processing of cotton fibers to finally produce fabrics and felts, involves considerable physical modification of their structure, (Ghosh, 2004). It may wrinkle easily. It is soft, breathes, absorbs body moisture, comfortable, strong and durable and versatile. (www.nanok.kids.clothing.com)

2.1.4 Uses of Cotton

Cotton is a comfortable fibre. Appropriate for year round use, it is the fiber most preferred for many furnishing and for warm-weather clothing, especially where the climate is hot and humid. Cotton is a very important furnishing fabric because of its versatility, natural comfort, and ease of finishing and dyeing. Towels are made of cotton because of its softness, absorbency, wide range of colours, and washability. (Sara, 2009) Cotton is a colourless body; soluble in water without taste or smell, but when smouldering gives off the characteristic of irritating odour of the gas acrolein, (Edge, 1998). The variation in fibre properties is reflected in yarn properties. The yarn or fabric made of naturally coloured cotton has a unique feature, (Basu et al., 2004).

Cotton is exclusively used in apparel fabric for men and women wears and household fabrics like bed sheets, towels, rugs and carpets. Cotton is blended with other man-made fibers like polyester, viscose and acrylic, to be used for variety of purposes. It can also be used in industrial applications as tyre cords, bags, shoes and medical supplies and equipments, (Jindal, 2007).The production of cotton woven cloth reveals that the growth of mill sector has been very slow, (Rao, 1994). It is the backbone of the world's textiles trade. Many of our everyday textile fabric are made from cotton. Fabrics those are hard wearing and capable of infinite variety of wearing and colouring, (Cook, 2005). Cotton is also used to make yarn used in crochet and knitting, (Rastogi, 2009).

2.2 Finishing

Textile finishing involves processes for improvement in the appearance of textiles. The cradle of fabric life spans from fiber to finished fabric. The finishing step is the last step in the processing of textiles. One important thing that should be kept in mind is that textile finishing is isolated from other processes such as scouring, bleaching, and colouration

processes (Choudhury, 2007). The handle, drape, fullness, sheen and usability of the fabric is improved to a large extent.

Textile finishing processes comprise washing, bleaching, dyeing and coating, as applied to bulk textiles or garments following weaving and or production of synthetic materials. These are energy-intensive and use large amounts of water that is generally discharged as effluent, (Van der Bruggen et al. 2004). Additionally, it is liable to change various physical and chemical properties of textile materials. Textiles are made with a wide variety of fibre compositions, yarns and fabric structures. The extent of a textile's finish is measurable in some cases, while in a large number of cases, the finish is related to sensory organs and is very much subjective, (Asim et al.,2017).

Textile finishing processes can be applied in different material forms such as fibre, yarn and fabric etc., the most common is fabric finishing. General expectations for all these finishing are having homogenous effect, non-damaged fibres, non-broken fabric, repeatable and economical process, low environmental impact and reduced energy and water consumption. Different application techniques are used and related to give desired properties to textile materials. Most of these application techniques are wet processes. These wet processes include exhaustion, impregnation, vacuum application, maximum application techniques as well as spraying, coating, transfer and foam application methods which are among the low-liquor application techniques. In addition to these methods, microencapsulation, plasma application, sol–gel technology and lamination techniques, which have become increasingly important in recent years, are also included in finishing applications, (Zeynep,2020)Textile finishing decides the ultimate appearance and aesthetic properties of textile material.

2.2.1 Need for finishing

Most fabric are somewhat untouched and unsatisfactory as taken from the loom, in order to increase its commodity value it is put through finishing process, (Menzes, et al.,2002).Textile finishing industry has been facing, innumerable challenges which have intensified during the past decade,(Casciani,2007) The problem of environmental pollution arising out of wet processing of textiles is also a major threat to the Indian textile export due to poor awareness about eco satisfaction prevailing in the western world,(Prayag,2001)

2.2.2 Classification of Finishing

There are primarily two types of textile finishing ,physical finishing such as calendering, emerizing, compressive shrinkage, shearing, etc. and chemical finishing involving different chemicals to induce a specific finishing (S.Wazed Ali,2022). The finishing can be classified into functional and aesthetic finishes . Some finishes which are increasingly being used include mosquito repellent finish , deodorant finish, wrinkle resistance ,easy care finish ,stone wash or enzyme wash ,bio finishing ,water proof, stain repellency but breathable finishes, moisture management, flame retardant finishes,(Rao et al.,,2005)

Aesthetic finishes

Aesthetic change the appearance and/ or hand of fabric .The finished fabric name many may change in appearance or the technique. They are applied to a fabric to alter some visual texture, hand or other aesthetic dimension of the fabric, (Rao et al.,,2005)

Additive finishes

Additive finishing chemical is added to the fabric to produce texture, luster, embossed designs, and abrasion resistance in the fabric,(Rao et al.,,2005)

Special –Purpose finishes

The chemical finishes that are applied to fabric to enhance performance for specific end uses. They add value and cost to textiles. Many functional finishes are topical to a chemical is added to the surface of the fabric penetrant,(Rao et al.,,2005)

2.2.3Advantages of finishing

Finishing means any modifications of fabric surface to meet certain desired needs or specification, (Sampath,2003). It is the final operation that makes the fabric presentable attractive,(Hall,2004).Finishing aims at increasing the aesthetic value, serviceability and comfort in textiles and is done to fibre, yarn or fabric either before the appearance , the hand or performance. Finishing treatment depends on various factors such as nature of the fibre, texture of the fibre, its physical properties, and use of material and so on, (Corbman,2015)

2.2.4Functional finishes

Special Finishes or functional finish are the treatment that are applied to the fabric to make them suited for specific uses such as easy care Finish, Flame Retardant Finish ,Water Repellent Finish, Soil repellent, Hydrophilic Finish ,
Anti –Bacterial Finish.

Functional textiles and clothing provide the expected traditional properties, like the appearance ,social identification, attraction, protection against cold and hot, easy-care, as well as some new properties and functions of thermo- conducting deodorant, avoidance of unpleasant odours ,antibacterial and antifungal protection,(Coman,et,al ,2010)

Flame Retardant Treatment

These are applied to combustible fabrics used in children's sleepwear, carpets and curtains and prevent highly flammable texiles from bursting into flame,(Coman,et,al ,2010)

Oil and water Proofing

Waterproof finishes allows no water to penetrate, but tend to be uncomfortable because they trap moisture next to the body .Recently, fabric have been developed that are waterproof and also breathable,(Coman,et,al ,2010)

Water- Repellent Finishes

Water-repellent finishes resist wetting. If the fabric becomes very wet, water will eventually pass through. Applied to fabric found in raincoats, all weather coats, hats, capes, umbrellas and shower curtains,(Coman,et,al ,2010)

2.3 Mosquito Repellent finishing

Mosquito repellent finish protects human beings from mosquito bites, thereby promising safety from mosquito-borne diseases.Malaria, dengue fever(DF),nile fever,Dengue Haemorrhagic Fever(DHF),chicken gunia and filariasis ,are serious public health problems in tropical region ,especially in Africa and Asia(Casciani 2003).These diseases are transmitted to human beings only through mosquito bites, since there is no effective vaccine available for the control of these diseases,prevention of mosquito bites is one of the main strategies to control or minimize incidence of these diseases. This repellent of plant material has been exploited for thousands of years by man ,most simply by hanging bruised plant in houses, a practice that is still in wide use throughout the developing, (Moore,et,al 2006) " Natural" smelling repellents are preferred because plant are perceived as a safe and trusted means of mosquito bite prevention ,(Casas et,al,2001). Mosquito menace has been spread all over the world and people tend to evolve one or more solution to protect themselves. The pre-treated sample is treated sample is treated with N-N Diethly Benz at different concentration at room temperature for 30 minute with water was found to be effective for mosquito repellency,(Van Langenhove, & Paul, R 2014).

2.3.1Eco friendly Mosquito Repellent Finish

Extensive studies have been carried out to assess the mosquito repellent properties or large number of plant product . Extract from , steam ,leaves ,flowers , fruit, and seeds of divers species of plant have been assessed for mosquito repellent properties. Monoterpenes such as limonene,citronella, camphor and thymol are common constituents of a number of essential oils that mosquito repellent activity,(Jaenson et al.,2006).

The herbal plant were identified and collected from the natural resources in a pure form. There are various natural mosquito repellents, citronella oil, clove oil, cedar oil, rosemary oil, lemongrass oil, among all the above- mentioned natural repellent, chrysanthemum was found to be the best repellent . Several natural and synthetic substances are identified as possessing mosquito repellent efficacy. There are many natural plants products which mosquito repellent properties. A Combination of natural substances apart from repellent , essential oil eucalyptus, cryptomeria japonica, nerium oleander flower extract . Dalbergiasissoo demonstrated high larvicidal activity against mosquito larvae, (Cheng,et.al.2007) There are many preparations from naturally occurring sources that have been used as a repellent to certain insects. Some of these act as insecticides while others are only repellent. Azadiraction, the active ingredient of neem has long been recognized for its mosquito larvicidal capability,(Das and Goswami,et,al,2007)

2.3.2 Chemical Mosquito Repellent Finishing

Deet (Di-Ethyl meta toluamide), Allethrin, Permethrin (synthetic analogue of pyrethurum) malathion. The mosquito repellent chemical has to be applied on to skin to make the human odour which is attracting the mosquito.

2.4 *Pelargonium zonale* (GERANIACEAE)

The Pelargonium species most often go by the common name annual geraniums or zonal geraniums. The scented geraniums repel mosquitoes better, with people favouring the more citrus scented flowers since many pests detest the smell of citrus. This plant is commonly found under a number of names, such as citronella plant, mosquito plant geranium, citrosa geranium, and Pelargonium citrosum. Though many of its names leave the impression that it contains citronella, which is a common ingredient in insect repellent, the plant is actually a variety of scented geranium that simply produces a citronella-like scent when the leaves are crushed. This plant is commonly found under a number of names, such as citronella plant, mosquito plant geranium, citrosa geranium, and Pelargonium citrosum.

Though many of its names leave the impression that it contains citronella, which is a common ingredient in insect repellent, the plant is actually a variety of scented geranium that simply produces a citronella-like scent when the leaves are crushed.

2.4.1 Physical Charecteristics of Geranium leaf

Pelargonium zonale is an upright or scrambling shrub, normally growing to about 1 m(3 ft) in height. Its stems are succulent, hairy when young and becoming woody with age. The leaves often have a narrow, dark, zigzag of pigmentation, giving rise to both the scientific and common names. The flowers are borne in an umbel, individual flowers are markedly zygomorphic. The petals are narrow and a bright, deep pink and red, with reddish lines along the petals' length. Leaves are reniform and petiolate with an average diameter of 5 to 8 cm.

2.4.2 Uses of Geranium leaf

Use dried leaves in a number of ways, including flavoring sugars and enhancing potpourri and sachets. Or add dried leaves to bath water for a luxuriously fragrant. The Rose of Attar and Pretty Polly (almond) varieties also adds a delicate flavour to sugar. It is an herb long used in South African traditional medicine. The root of the plant is typically distilled into an extract and used in cough and cold remedies to alleviate symptoms and reduce the duration of illness, (Whitlock, 2020). As a medicinal plant, geranium has traditionally been considered an astringent and used as a folk remedy in the treatment of ulcers. A terpine hydrate synthesized from geraniol is known to be, an effective expectorant. Leaves are reported to have antifungal activity, (L.E. Craker et,al. 1984).

2.4.3 Chemical Constituents

Pelargonium zonale (Geraniaceae) was characterized with respect to its chemical composition, antioxidant potential and antimicrobial activities. This is the first investigation focusing on the comparison of both essential oil and polar extracts from this species. The chemical composition of the essential oil of the aerial parts of P. graveolens was analyzed by Gas Chromatography/Mass Spectrometry(GCMS). The main constituents of the oil were found to be β-citronellol (21.9%), citronellyl formate (13.2%), geraniol (11.1%), 10-epi-γ-eudesmol (7.9%), geranyl formate (6.2%) and (l)-linalool (5.6%). Nine flavonoids were identified by High-Performance Liquid Chromatography (HPLC) in leaf and flower extracts, (Boukhris et al., 2013)

3. EXPERIMENTAL PROCEDURE

The methodology of this study on **"Assessing the Functional Properties of Cotton Fabric Treated with Geranium Extract"** has been discussed under the following headings;

3.1Selection of fabric

3.1.1 Pretreatment of selected fabric

3.2 Selection of source

3.2.1 Plant Authentication

3.2.2 Collection and Processing of source

3.3 Method of finishing on the fabric

3.3.1 Pilot Study

3.3.2 Final Study

3.4 Mosquito Repellency Test

3.4.1 Cage Test

3.4.1.1 Cage preparation

3.4.1.2 Mosquito collection

3.4.1.3 Testing the treated fabrics before and after wash

3.4.1.4 Testing procedure

3.5 Nomenclature

3.6 Objective Evaluation

3.6.1 Fabric Weight

3.6.2 Fabric Thickness

3.6.3 Tensile Strength and Elongation

3.6.4 Fabric Stiffness

3.6.5 Fabric Crease Recovery

3.7 Absorbency Property

3.7.1 Sinking test

3.7.2 Drop test

3.7.3 Wicking

3.8 Antimicrobial Test

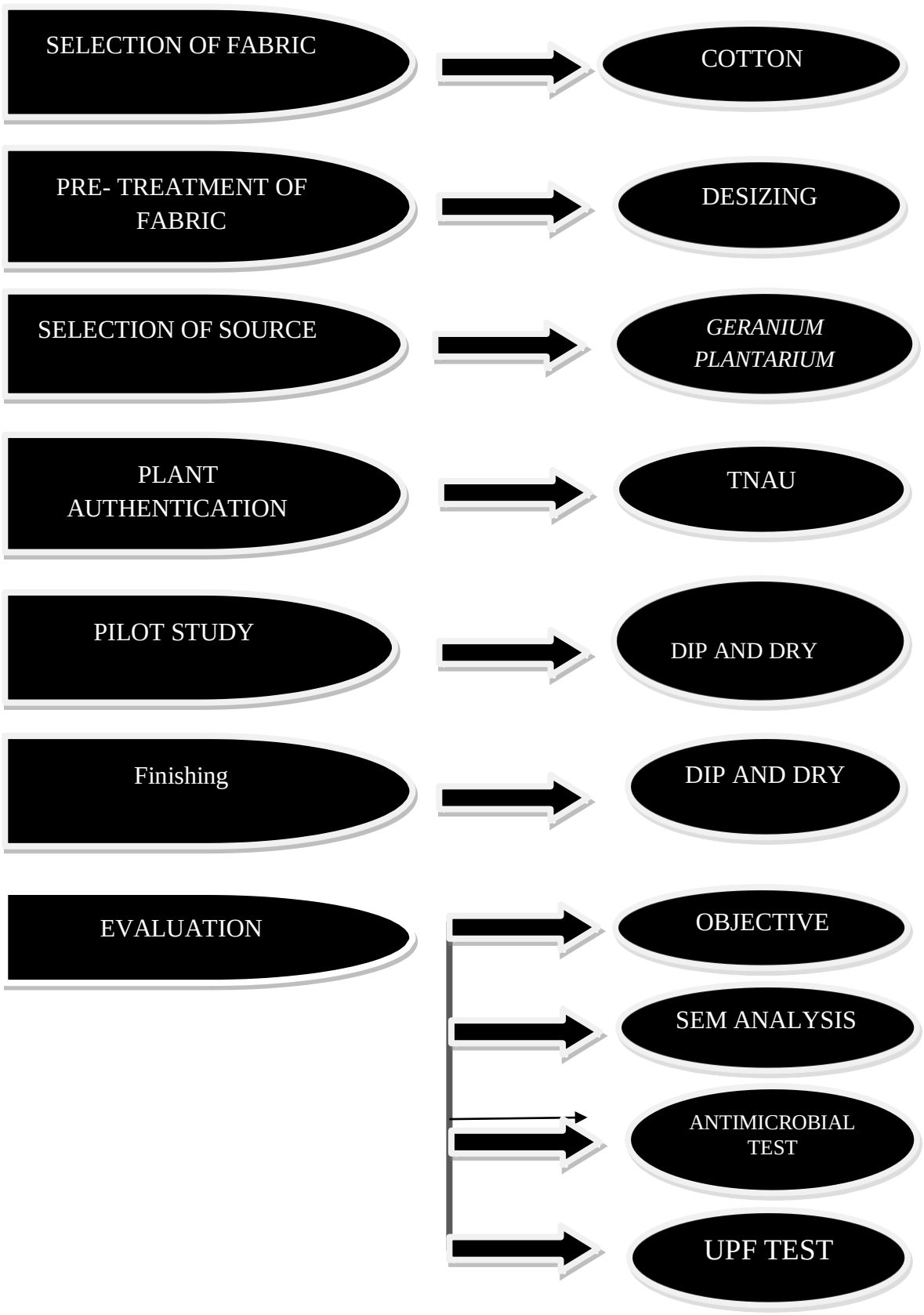
3.9 UPF Test

3.10 SEM Analysis

3.11 Statistical Analysis

3.12 Product Development

FLOW CHART FOR EXPERIMENTAL PROCEDURE



3.1 Selection of fabric:

Cotton fibres are natural hollow fibres. These are soft, cool, known as breathable fibres and absorbent. Cotton fibres can hold water 24–27 times their own weight. They are strong, dye absorbent and can stand up against abrasion wear and high temperature, (Hosseini ,2011). Cotton fabric has been used for various end applications. Therefore the investigator has selected cotton fabric for developing functional textiles.

3.1.1 Pretreatment of selected fabric

Desizing

Desizing is the process of removing the size material from warp yarns after a textile fabric is woven. Desizing process increases the absorbency power to the fabric. Hence the selected fabric was desized following the recipe given in Table I ;

Table I

Cotton Material	2 meter
Material : Liquor ratio	1:20
Sodium Hydroxide	3%
Temperature	90°c
Time	1 hour

Procedure

The selected material was desized in a bath containing Sodium hydroxide of 3% and 2 liters of water at 90°c for 1 hour. Cool down to 70°c and then switch off the bath. After desizing, the material was washed thoroughly with warm and cold water successively. Then the material was dried.

3.2 Selection of source

Pelargonium and Geranium were placed together under the same genus, Geranium of the family Geraniaceae, (Sweet, 1820). Pelargonium is recommended to treat bronchitis, colds, the flu and even sinusitis and its extracts are usually well tolerated. The genus Pelargonium comprises scented and unscented species. The odour of the leaves of various scented Pelargonium species range from pleasantly fruity or floral to rather oppressively balsamic, (Demarne and Van der Walt, 1989). Considering the presence of odour and mosquito repellent nature the investigator has selected the plant for the study.

Plant Details:
Pelargonium
Botanical Name: Geranium
Family: Geraniaceae

Plate 1 - Pelargonium

3.2.1 Plant Authentication

The selected plant was submitted to the department of Herbarium Tamil Nadu Agricultural University, Coimbatore for plant authentication and the report is given in Appendix1. The botanical name of the selected plant is identified as GERANIACEAE.

3.2.2 Collection, Processing and Extraction

The planetarium zonale (GERANIACEAE) was collected from a botanical garden at Ooty. 200 grams of leaves were collected, cleaned and washed thoroughly to remove dirt and soil. Natural extract from the selected leaf was done following the proportions given in Table II ;

Table 11

Geranium leaf	1.5 kg
Water	1.5litre

Procedure

To obtain extract from the selected source was ground in a mixture grinder and filtered. Upon filtration 1500ml of extract was obtained then the filtered extract was stored in a air tight container and kept in a refrigerator for further study as suggested by Thilagavathi et.al.(2007).

Plate 2 - Natural Extract

3.3 Method of finishing fabric

3.3.1 Pilot Study

The plant extract was taken in three different beakers with the material liquor ratio of 1:10, 1:20, and 1:30. Cage test was done to find out the mosquito repellency. Based on the subjective observation 1:10 material to liquor ratio was found to be good.

3.3.2 Final study

The plant extract is taken in a container then the dried fabric is dipped into the solution for 24 hours. Then the fabric is rinsed and dried thoroughly.

Table 111

Fabric	Cotton Material
Solution	Geranium leaf extract
Time	24 hours
Temperature	Room temperature

Plate 3 – Dip and Dry Method

3.4 Mosquito repellent Test:

3.4.1 Cage Test

3.4.1.1 Cage Preparation:

The repellency test was done by preparing a cage and collecting 10 mosquitoes.20cm x20 cm cages was prepared. The two opposite sides and the bottom cover were prepared with plastic box. And the top is covered with a cap. The plastic box is perforated for enough air circulation.

3.4.1.2 Mosquito collection:

10 mosquitoes were used for the test. The mosquitoes were collected from nearby garden. A big flask and covers were used to collect the mosquitoes.

3.4.1.3 Testing the Treated fabrics before and after wash:

The repellency test of the sample was done on the basis of the standard with some minor modifications. The observations and modifications are: While the mosquitoes are inserted in to the cage they tend to sit/rest on the wall of the cage and on the ground. So the testing method was modified by placing the treated samples on the wall of the cage and the number of mosquitoes arrived on the treated samples were counted and recorded within 30 minutes

3.4.1.4 Testing Procedure:

The treated samples were put into the cage. One sample is tested at a time. Then the mosquitoes are inserted into the cage. The number of mosquitoes arrived on the treated samples were collected and recorded for 30 minutes per sample. Since the mosquitoes settle on a place where they sit first (when it is convenient for them) they may not fly to other place. So the cage had been shaked each 5 minutes to disturb the mosquitoes. Now at this time they will try to sit again and counting and recording the number of mosquitoes had been done. (Plate 5). The same procedure is done after washing the treated fabric.

Plate 4

3.5 Nomenclature

The nomenclature of the sample is presented below;

Table IV

Nomenclature	**Details of fabric**
OS	Original Sample
MRT1	Mosquito Repellent Treated 1
MRT2	Mosquito Repellent Treated 2

M- Mosquito **R**- Repellent **T**-Treated **1**- Before wash **2**- After wash

3.6 Objective Evaluation

3.6.1 Fabric Weight:

The fabric weight was found according to ASTM test method D3776-2002. The weight can be determined by a mass per unit area or a mass per unit length of fabric. Specimen of known dimension is taken by a cutting device or a template to obtain a consistent specimen size. The fabric weight or fabric mass describes how much a fabric weight for a given area or length of fabric (Sara, 2009). A sample of 10cm × 20cm was cut using a GSM Cutter and Electronic Weighing Balance (Plate 6) was used to find out the weight of samples.

3.6.2 Fabric Thickness:

Fabric thickness was determined in accordance with test method ASTMD-1777-2002 after preconditioning as specified in practice ASTM D 1776. Fabric thickness is a important variable in determining fabric thickness and hence extend to which the fabric will drop and comfort. Fabric thickness is most important variable determining the rate of heat transfer and hence the so called 'warmth' of fabric. The fabric thickness affect air permeability and moisture absorbency and also has a great influence in the abrasion resistance (AU,2011)

The Hungarian Thickness Test (Plate 7) was used. It has anvil the pressure foot, which works under a lever spring action. Each division on the dial read is 0.01mm. The sample was placed on the anvil plate lever of the pressure foot release vary slowly pressure foot pressured the sample. Ten readings were taken from different place of fabric sample and the mean was calculated.

3.6.3 Tensile Strength and Elongation:

The Eureka Model Tensile Strength Tester (Plate 8) was used for this study. The rate of transfer and the capacity of the machine were 48centimeter per minute and 90 kilogram respectively. The gauge length was kept as 25 centimeters. The dial of the machine was calibrated in pounds and kilograms (Nakamura,2010). The tensile properties measured are generally considered arbitrary rather than absolute, (Hurren, 2008).

Fabric strength was measured in warp and weft direction according ASTM D5035 method. Tensile Strength Tester is used to evaluate the untreated and treated fabric. Each sample was 12cm in length and 2/12cm in width. Sample O was clamped between the jaws.

It is necessary to see whether the sample was perpendicular to the load. The load was applied and the readings were noted in pounds and the elongation in inches as well as centimeters was noted as soon as the sample was broken. Ten readings were taken and the mean strength and elongation is calculated to measure the strength loss or gain in the fabric before and after finishing.

3.6.4Fabric Stiffness:

Stiffness is the resistance to bending . Fabric stiffness indicates the resistance of the fabric to bending and it is a key factor in the study of handle and drape. (Angappan, et, al.2000).

A measure of the interaction between fabric weight and fabric stiffness as shown by the way in which a fabric bends under its own weight. ASTM D1388-96(2002) (Plate 9). Stiffness is a special property of fabric. It is a tendency of fabric to keep standing without any support. A rectangular strip of fabric, 6 cm × 1 cm is mounted on a horizontal platform in such way that it over change, like a cantilever, and bends downwards. Three specimens in warp and three in weft are usually tested and since the relative humidity can affect the results the test should be made in a standard testing atmosphere. The horizontal platform of the instrument is supported by two side pieces made of plastic. Attached to the instrument is a mirror which enables the operator to view both index lines from a convenient position. The scale of the instrument is graduated in centimeters of bending length and it also serves as the template for cutting the specimens to size. The ten samples readings was taken and mean value is calculated.

3.6.5Crease Recovery:

A measure of crease resistance specified quantitatively in terms of certain parameters such as crease recovery angle, (Maitra, 2007).

Shirley Crease Recovery Tester (Plate 10) was used for this testing. The samples were folded face to face, end to end and held it with tweezers without touching the specimen with anything other than tweezers. Placed the folded specimen between the two leaves of the loading device and immediately applied the weight. Removed the weight after five seconds from the specimen so that the specimen pressed does not spring open. Using tweezers transfer the folded specimen between the clamps on the specimen holder, leaving the other end to hang freely.

While the specimen is in the holder, adjust the instrument to keep the free hanging end of the specimen in alignment with the vertical mark. Frequent adjustment for 5 minutes is necessary to avoid gravitational effect and the degree is noted.

3.7 Absorbency Property

3.7.1 Sinking test

This involves a simple test for wettability of fabric. In this test, a small square specimen 1x 1 inch is cut and dropped into the surface of water in a beaker. The time taken for the specimen to sink below the surface is observed. The shorter time, the greater the wettability (Raul, 2005)

Sinking test is a sample test of wettability of fabric. In this test a sample measuring 5" x 5" was cut and dropped into the surface of water in a beaker. 100ml beaker was filled with distilled water and added few drops of wetting agent into distilled water. The sample was dropped on the surface of the water from a standard height. The stop watch was started when the fabric stuck the surface of water and stopped when the last corner sank below the water surface and the time required for the sample to sink was noted. The same procedure was repeated for five samples. Then the mean value was calculated for the above samples. Similarly the mean value of the original and treated fabric material were calculated and the sinking time of each material was recorded separately.

3.7.2 Drop test

The Drop test is a count of number of drops required to penetrate through to the under scale of the fabric when all the drops fall on the same spot (AATCC, Technical manual 2008)(Plate 11). A burette filled with distilled water was clamped in a stand was mounted in an embroidery frame and was placed at the base of the stand . The distance between the sample and the burette nozzle was 2.5" kept constant. The nozzle of the burette was opened just to allow a drop of water fall on the sample. The stop watch was started simultaneously and it was stopped when the drop of water fully sank into the material. The same procedure was done by ten times for the original and treated samples and then means value was calculated.

3.7.3 Wicking test

Liquid movement which is primarily perpendicular to the plane of the fabric is termed transplanar uptake or transplanar flow. Transplanar uptake is also referred to as “demand wettability”. Liquid flow in a direction parallel to the plane of the fabric is termed planar uptake or planar flow and is also referred to as “wicking” (Johnson et al., 1996)

A strip of fabric was suspended vertically with its lower edge in reservoir of distilled water. The rate of rise of the leading edge of water was then noted. To detect the position of water line a dye was added to the water after 30minutes and the rise in the water line was noted. The measured height of rise in 30minutes was taken as a direct indication of the test fabric and recorded in centimeters.

3.8 Antimicrobial Test

Antimicrobial textile with improved functionality find a variety of applications such as health and hygiene products specially the garments worn close to skin and several medical applications, such as infection control and barrier material,(Joshi et al,2009).

The treated sample was given to the Department of Microbiology, Dr.N.G.P College of Arts and Science, Coimbatore to verify the antimicrobial property in the given sample for further study. The antimicrobial property detail is presented in Result and Discussion chapter.

3.9 UPF Test

The UV Protection Factor (UPF) of a fabric specifies how much UV mediation (including UVB and UVA) can reach your skin. The UPF stands for Ultraviolent Protection Factor and it are determined using AATCC 183 - 2010 method. It is used to determine the fabric's UV protection capabilities. A spectrophotometer or spectroradiometer is used to measure the transmission of ultraviolet radiation (UVR) through a specimen at known wavelength intervals. The ultraviolet protection factor (UPF) is calculated as the difference between the erythemally weighted UV-R irradiance at the detector with no specimen and the erythemally weighted UV-R irradiance at the detector with a specimen present. The sum of wavelength intervals of the measured spectral irradiance times the relative spectral effectiveness for the relevant erythemal action spectra times the UV-R weighting function of the appropriate solar radiation spectrum times the appropriate wavelength interval is the erythemally weighted UV-R irradiance at the detector with no specimen present. The sum of wavelength intervals of the measured spectral irradiance times the relative spectral effectiveness for the relevant erythemal action spectrum times the spectral transmittance for the specimen times the wavelength interval is the erythemally weighted UV-R irradiance at

the detector with a specimen present. UPF is defined as the ratio of the average effective UV irradiance calculated for unprotected skin to the average UV irradiance calculated for skin protected by the test fabric. The higher the value, the longer a person can stay in the sun until the area of skin under the fabric becomes red. UVA and UVB radiation blocking percentages are also computed (AATCC 2019). The UPF Test detail is presented in Result and Discussion chapter.

3.10 SEM Analysis

Treated and untreated sample were examined in a Scanning Electronic Microscope and details are presented in Results and Discussion chapter.

3.11 Statistical Analysis

Statistical analysis of the study

The findings of untreated and treated samples were analyzed using F test to analysis difference between the two samples value.

3.12 Product Development

The mosquito repellent finished fabric is converted into usable patches as given in Plate 5.

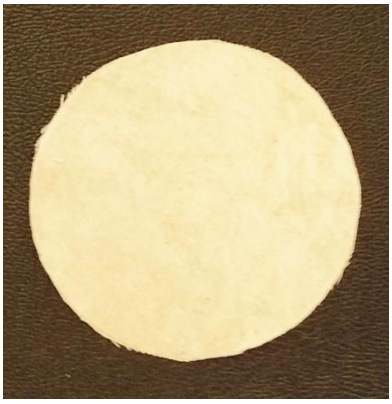


Plate 5

Plate – 6 GSM Cutter

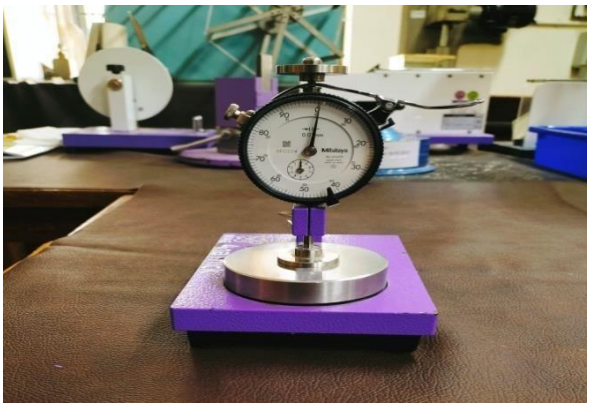


Plate -7 Thickness

Plate – 8 Tensile Strength Tester

Plate- 9 Stiffness Tester

Plate- 10 Crease Recovery Tester

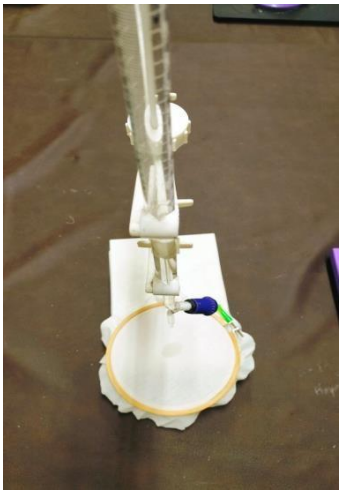


Plate-11 Drop Tester

4. RESULTS AND DISCUSSION

The results and discussion of the research work carried out on **"Assessing the Functional Properties of Cotton Fabric Treated with Geranium Extract"** is presented under following headings;

4.1 Objective evaluation

4.1.1Assessment of physical properties

4.1.1.1Fabric Weight

4.1.1.2 Fabric Thickness

4.2Assessment of Mechanical Properties

4.2.1 Tensile Strength and Elongation

4.1.1.2.1 Tensile Strength and Elongation in warp direction

4.1.2.1 .b) Tensile Strength and Elongation in weft direction

4.1.3 Assessment of Comfort Property

4.1.3.1Fabric Stiffness

4.1.3.1.1 Fabric Stiffness in warp direction

4.1.3.1.2 Fabric Stiffness in weft direction

4.1.3.2 Crease Recovery

4.1.4 Absorbency Test

4.1.4.1 Sinking Test

4.1.4.2 Drop Test

4.1.4.3 Wicking Test

4.1.5 Mosquito Repellence Test

4.2.5.1 Cage Test

4.2 Antimicrobial Test

4.3 Scanning Electron Microscope (SEM) Analysis

4.4 UPF Test

4.1 Objective evaluate

4.1.1 Assessment of physical properties

4.1.1.1 Fabric weight

Fabric weight of the original fabric, mosquito repellent fabric and statistical analysis is presented in the Table V and Figure I

TABLE V

FABRIC WEIGHT

Samples	Mean Weight (GSM)	Gain/loss Over original	%Gain/Loss Over original	"F" Value
OS	1.27	-	-	1.825^{ns}
MRT1	1.38	0.06	4.47	
MRT2	1.34	-0.03	2.34	

ns- not Significant

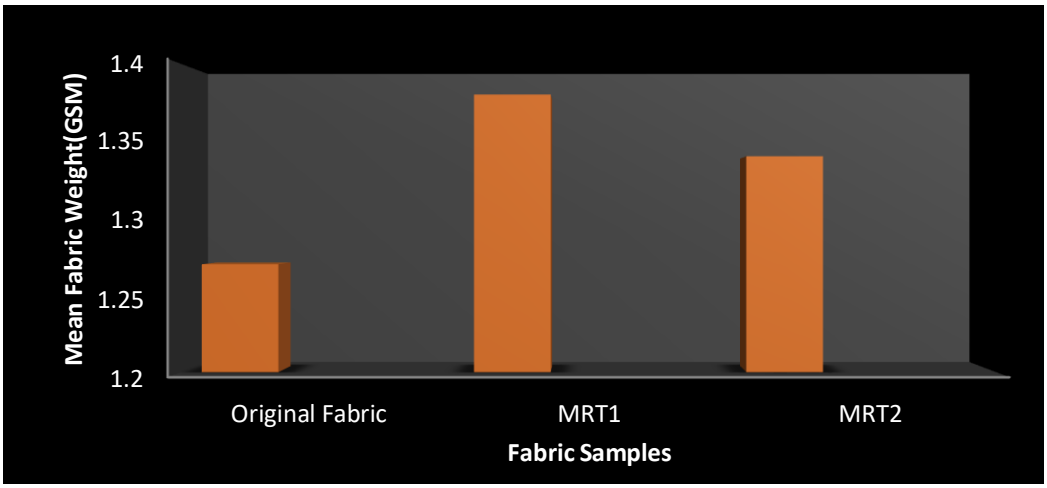


FIGURE 1

FABRIC WEIGHT

From the Table VI and Figure 1 show the difference of the weight loss or gain before and after treatment of fabric with selected source. The values expressed that the natural extract finished fabric weight has increased when compared with original samples and after washing, the weight of the treated sample has decreased. Percent weight gain of the treated sample MRT1 was noted to be 4.47 percent increase than the original sample. Between MRT1 and MRT2, percent weight decrease exhibited by MRT2 was noted to be 2.89 percent. Finishing with natural extract has slightly increased the weight of the fabric. However Statistical analysis proved that there was no significant difference.

4.1.1.2 Fabric Thickness

Fabric thickness of the original fabric, mosquito repellent fabric and statistical analysis is presented in the Table VI and Figure 2

TABLE VI
FABRIC THICKNESS

Samples	Mean Thickness (mm)	Gain/Loss Over original	%Gain/Loss Over original	"F" value
OS	0.29	-	-	1.68^{ns}
MRT1	0.37	-0.08	27.58	
MRT2	0.31	0.13	35.13	

ns – not Significant

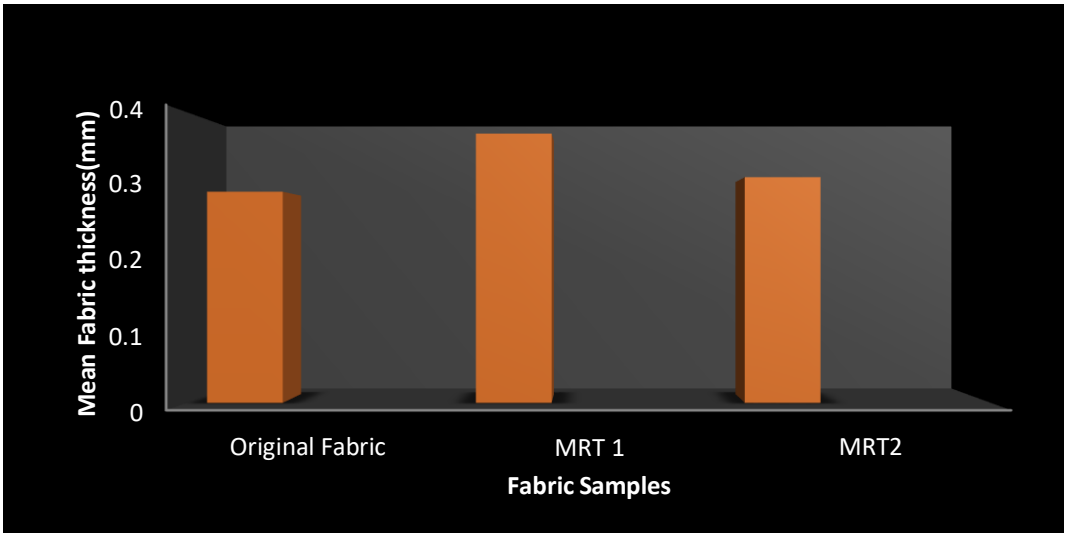


FIGURE 2

Fabric Thickness

Table VII and Figure 2 clearly show that the thickness of fabric increased after finishing when compared with the original fabric. However after washing, thickness of the finished fabric decreased. Percent increase in thickness as exhibited by MRT1 and MRT2 was 27.58 and 35.13 respectively. Between MRT1 and MRT2, unwashed sample MRT1 showed decrease in thickness by 16.2 percent. This might be due to washing. Statistical analysis also proved that there was no significant difference.

4.1.2 Assessment of Mechanical Properties

4.1.2.2 Tensile Strength and Elongation

4.1.2.1.a) Tensile Strength in warp direction

Fabric strength and elongation of the original fabric, mosquito repellent fabric and statistical analysis is presented in the Table VII and Figure 3.

TABLE VII

Fabric Tensile Strength - Warp

Samples	Mean Strength (kg)	Gain/Loss Over original	%Gain/Loss Over original	"F" Value
OS	81	–	–	15.76
MRT1	48.5	32.5	40.12	
MRT2	42.8	5.7	11.75	

Significant at 1% level.

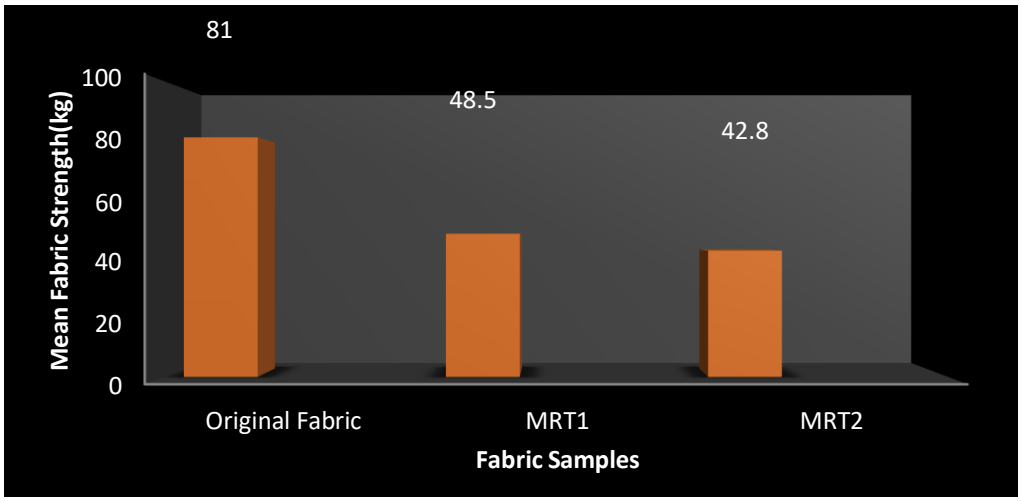


FIGURE 3

Fabric Tensile Strength - warp

Table VIII and Figure 3, it is evident that the strength of before and after treatment of samples along warp direction showed significant difference. After finishing the strength of the sample MRT1 has decreased by 40.12% when compared to original sample. Comparing the samples MRT1 and MRT2, the strength exhibited by MRT1 (48.5) was higher than the sample MRT2(42.8). Statistical analysis also proved that there was a significant at 1% level.

4.1.2.1 .b) Tensile Strength in weft direction

Fabric strength and elongation of the original fabric, mosquito repellent fabric and statistical analysis is presented in the Table VIII and Figure 4.

TABLE VIII

Fabric Tensile Strength-Weft

Samples	Mean Strength (kg)	Gain/ Loss Over original	%Gain/Loss Over original	"F" Value
OS	63.2	-	-	2.11
MRT1	49.8	13.4	21.20	
MRT2	37.4	12.4	24.89	

Significant at 1% level

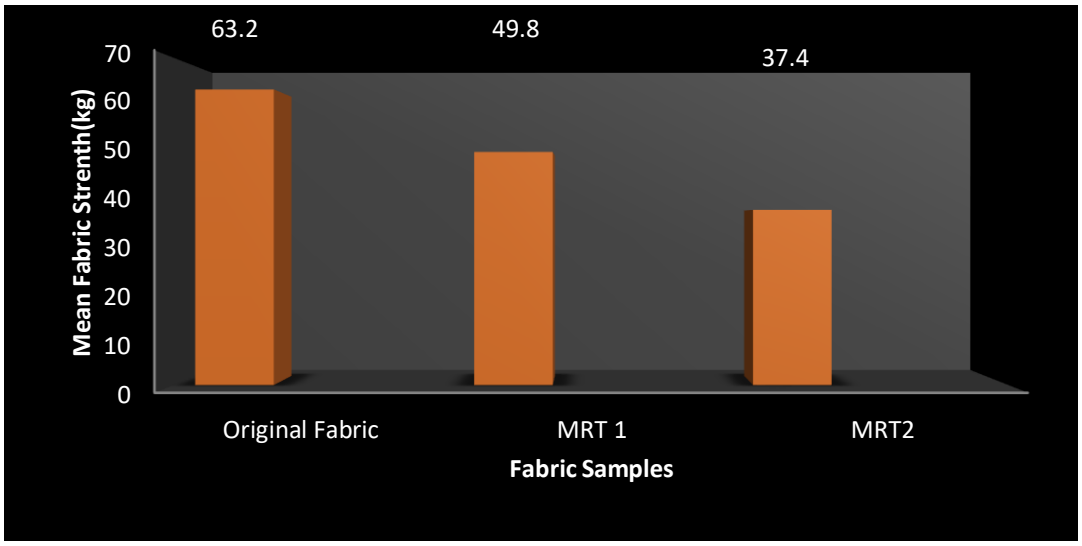


FIGURE 4

Fabric Tensile Strength -weft

Table IX and Figure 4, it is evident that the strength of before and after treatment of samples along weft direction showed significant difference. After finishing, strength of the sample MRT1 has decreased by 21.20 per cent when compared to the original sample. Comparing the finished samples, strength exhibited by MRT1 (49.8) was higher than thesample MRT2 (37.4). Statistical analysis also proved 1% significant difference between samples.

4.1.3 Assessment of Comfort Property

4.1.3.1Fabric stiffness

Fabric stiffness in warp direction

Fabric Stiffness in warp of the original fabric, mosquito repellent fabric and statistical analysis is presented in the Table IX and Figure 5.

TABLE IX

Fabric Stiffness -Warp

Samples	Mean Stiffness (cm)	Gain/Loss Over original	%Gain/Loss Over original	"F" Value
OS	1.98	-	-	0.138^{ns}
MRT1	2.92	-0.94	47.47	
MRT2	2.65	0.27	9.24	

ns-not significant

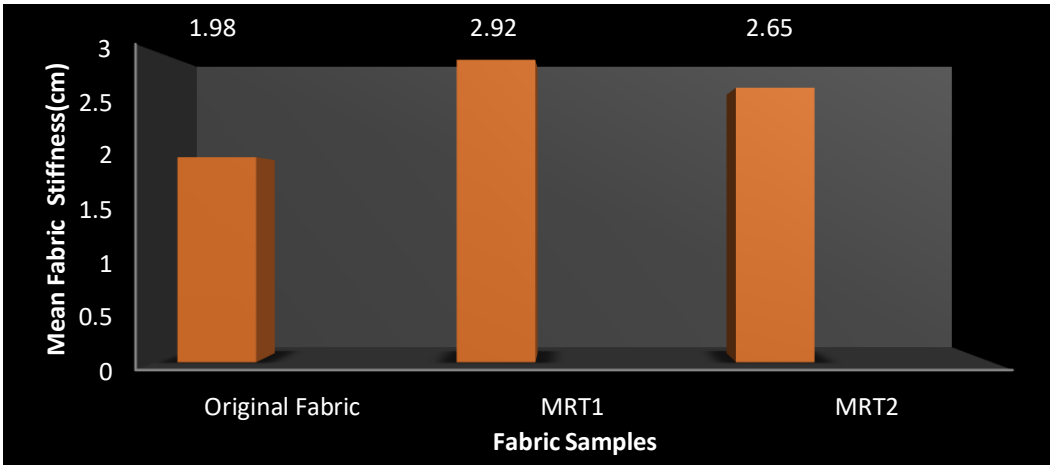


FIGURE 5

Fabric Stiffness - Warp

Table X and Figure 5 show the difference of stiffness increase or decrease before and after treatment. Mean decrease in stiffness of the samples MRT1 and MRT2 was recorded to be 2.92 and 2.65 respectively. Finishing with selected natural extract has enhanced the comfort property of fabric. Statistical analysis proved that there was no significant difference.

Fabric stiffness in weft direction

Fabric stiffness in weft of the original fabric, mosquito repellent fabric and statistical analysis is presented in the Table X and Figure 6.

TABLE X

Fabric Stiffness-Weft

Samples	Mean	Gain/Loss	%Gain/Loss	F Value
OS	1.75	--	--	0.65^{ns}
MRT1	2.15	-0.4	22.85	
MRT2	1.45	0.7	32.55	

ns- not significant

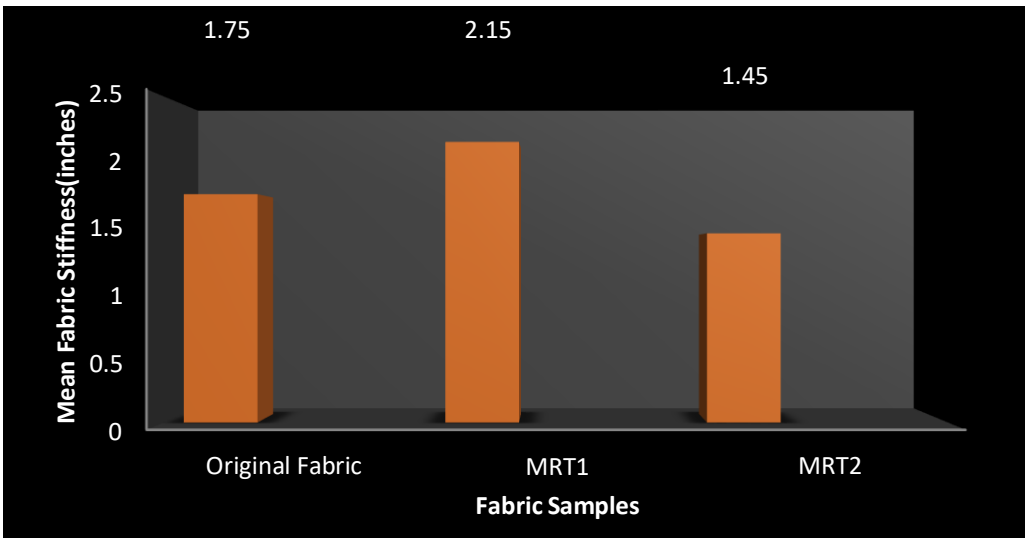


FIGURE 6

Fabric Stiffness - Weft

Table XI and Figure 6, difference in stiffness of fabric before and after treatment increased after finishing and decreased after washing. The stiffness is decreased in weft direction of the sample due to the absorbency of the natural source exhibited by the samples MRT1 (22.85) and MRT2 (32.55).Statistical analysis proved that there was no significant difference.

4.1.3.2 Crease Recovery

Fabric crease recovery of the original fabric, mosquito repellent fabric and statistical analysis is presented in the Table XI and Figure 7.

TABLE XI

Crease Recovery

Samples	Mean Crease recovery (Degree)	Gain/ Loss Over original	%Gain/Loss Over original	"F" Value
OS	63.4	-	-	1.15
MRT1	80.8	-17.4	27.44	
MRT2	93.7	-12.9	15.96	

Significant at 1% level

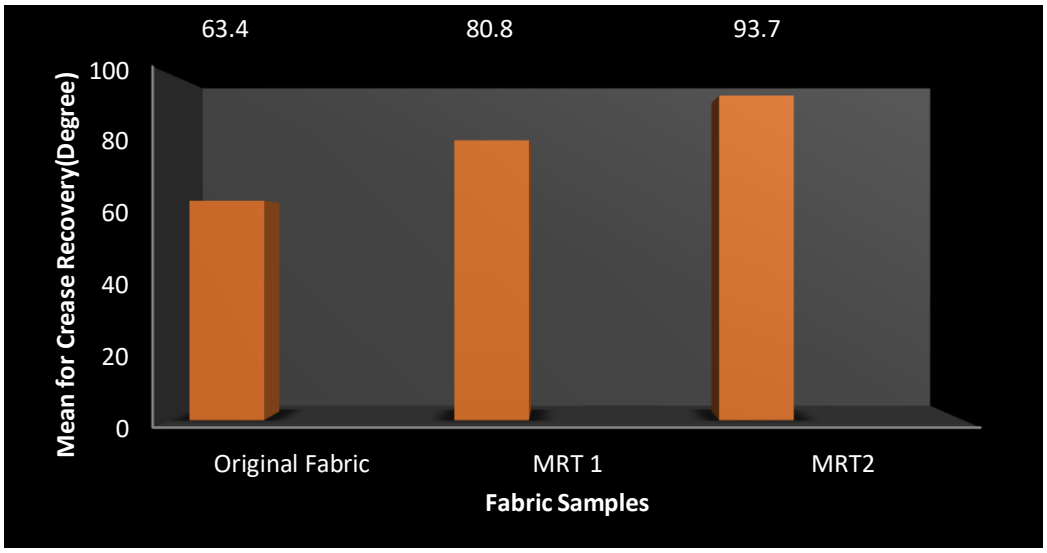


FIGURE 7

Crease Recovery

Table XII and Figure 7, exhibit the crease recovery angle of before and after treated fabrics. After finishing the crease recovery has increased than the original fabric by 27.44 (MRT1) and 15.96(MRT2) percent. Natural finishing has enhanced the crease recovery angle and hence the comfort property is improved. Statistical analysis also proved that there was a significant difference at 1% level.

4.1.4 Absorbency Test

4.1.4.2 Sinking test

Fabric sinking test of the original fabric, mosquito repellent fabric and statistical analysis is presented in the Table XII and Figure 8.

TABLE XII
Sinking Test

Samples	Mean Sinking time (sec)	Gain/Loss Over original	%Gain/Loss Over original	"F" Value
OS	13.97	-	-	0.13^{ns}
MRT1	15.25	-1.28	9.16	
MRT2	15.09	0.16	1.04	

ns- not significant

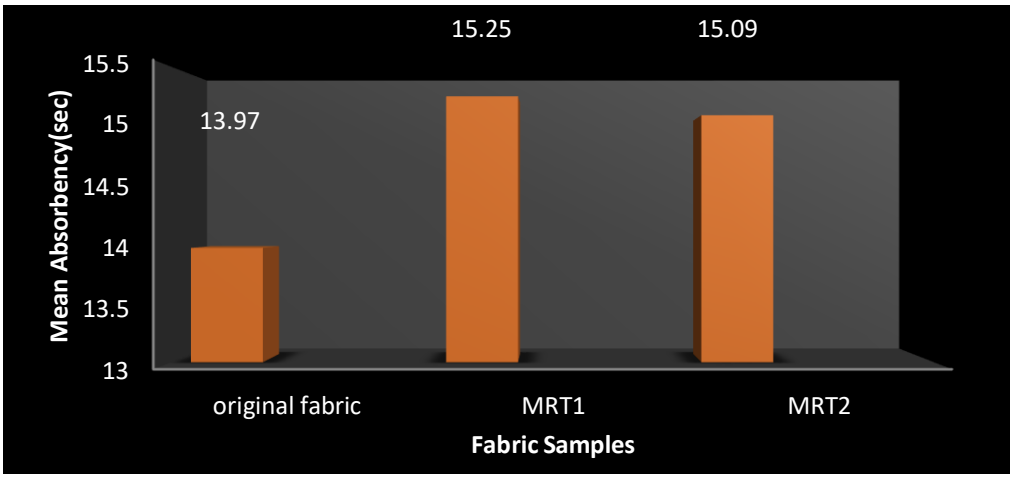


FIGURE 8
Sinking Test

Table XIII, Figure 8 show that the time taken for the before and after treated samples to sink. After finishing, the sinking time has increased by 9.16 and 1.04 among the sample MRT1 and MRT2. However the Statistical analysis proved that there was no significant difference. Finishing with natural extract has not affected the absorbency property of the fabric.

4.1.4.3 Drop Test

Fabric drop test of the original fabric, mosquito repellent fabric and statistical analysis is presented in the Table XIII and Figure 9.

TABLE XIII
Drop Test

Samples	Mean Absorbency(sec)	Gain/Loss Over original	%Gain/Loss Over original	"F" Value
OS	11.58	-	-	0.028
MRT1	10.38	1.2	10.36	
MRT2	10.60	-0.22	2.11	

ns- not significant

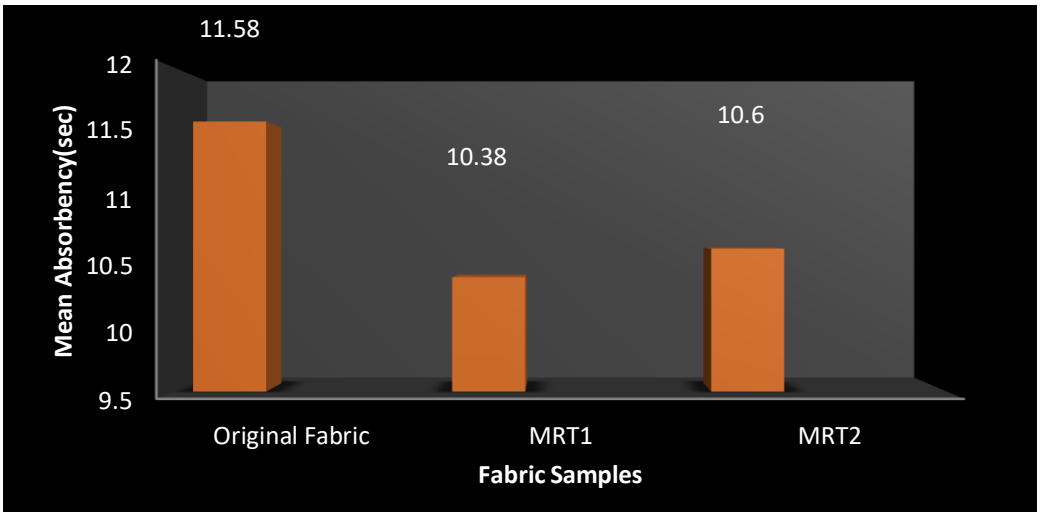


FIGURE 9
Drop Test

Table XIV and Figure 9 it is understood that the time taken for the samples to absorb water droplet fully. It was noted that treated samples before and after washing could absorb a droplet of water within 10.38(MRT1) and 10.60(MRT2) seconds while original fabric took 11.58 seconds . Therefore it can be inferred that finishing has enhanced the absorbency property of the fabric. However Statistical analysis proved that there was no significant difference.

4.1.4.4 Wicking test

Fabric wicking test of the original fabric, mosquito repellent fabric and statistical analysis is presented in the Table XIV and Figure 10.

TABLE XIV
Wicking test

Samples	Mean Wicking time (sec)	Gain/Loss Over original	%Gain/Loss Over original	"F" Value
OS	9.78	-	-	1.62
MRT1	10.77	0.99	10.1	
MRT2	10.22	0.55	5.62	

ns- not significant

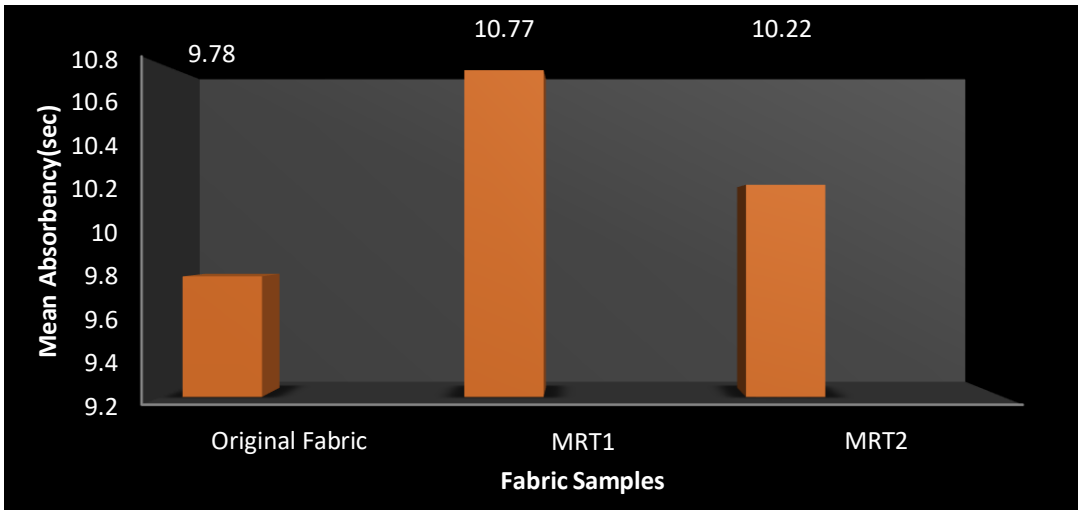


FIGURE 10

Wicking Test

Table XV and Figure 10 show the time taken for the before and after treated samples to wicking. After finishing, the wicking time has increased by 9.78 and 10.77 per cent among the sample MRT1 and MRT2. However the Statistical analysis proved that there was no significant difference. Finishing with natural extract has not affected the absorbency property of the fabric.

4.1.5 Mosquito Repellence Test

4.1.5.1 Cage test

Cage test of the original fabric, mosquito repellent fabric presented in the Table XV and Figure 11

TABLE XV
Cage Test

Samples	No. of Mosquitoes	Died	Drowsy	Alive
OS	10	-	1	9
MRT1	10	3	5	2
MRT2	10	1	4	5

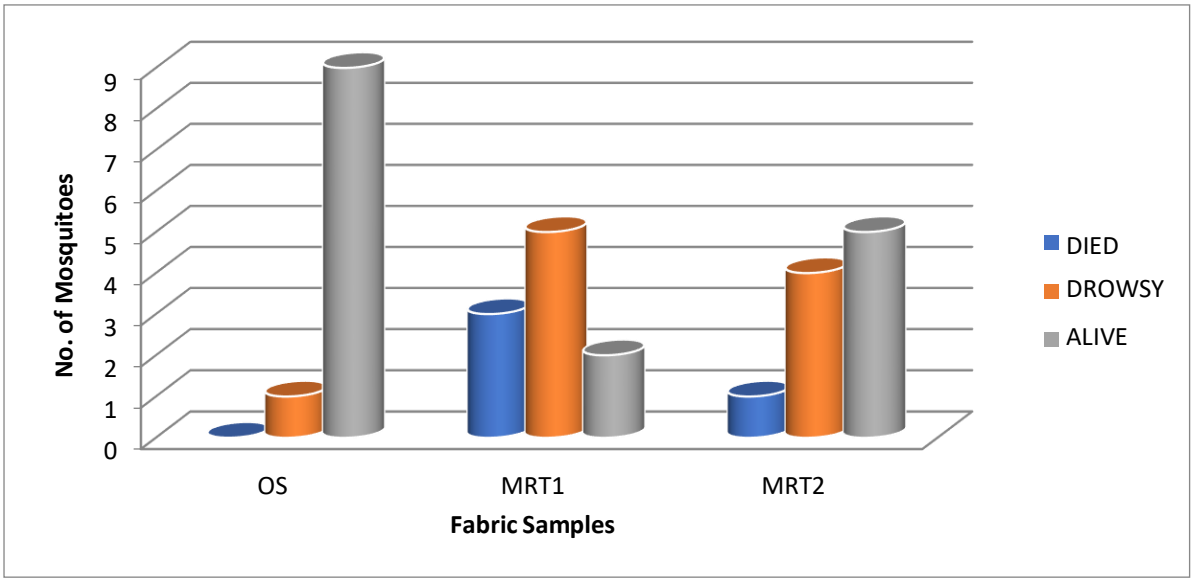


FIGURE 11

Cage Test

From the above table 11 it is found that the natural extract finished sample possess mosquito repellency when cage test is carried out, sample MRT1 was effective as 5 mosquitoes were drowsy and 3 died only 2 mosquitoes were alive. As for MRT2 is concerned, 1 mosquito has died and 4 were drowsy while 5 were alive. This may be due to washing of sample. MRT2 can be replenished with natural finishing to improve mosquito repellency. The study conducted by Debra Sullivan, 2019 found mosquito repellent effect when natural extract was used on fabric as finishing.

4.2 Antimicrobial Test

The result of the Antimicrobial test carried out for the natural extract is expressed in Table XVI and Figure 12.

TABLE XVI
Antimicrobial Test

S.No	Test Organisms	Results OD Values		
		0.5	**1**	**1.5**
1	**E- Coli**	1.19	1.12	1.73
2	**Bascillus sp**	1	1.12	1.70

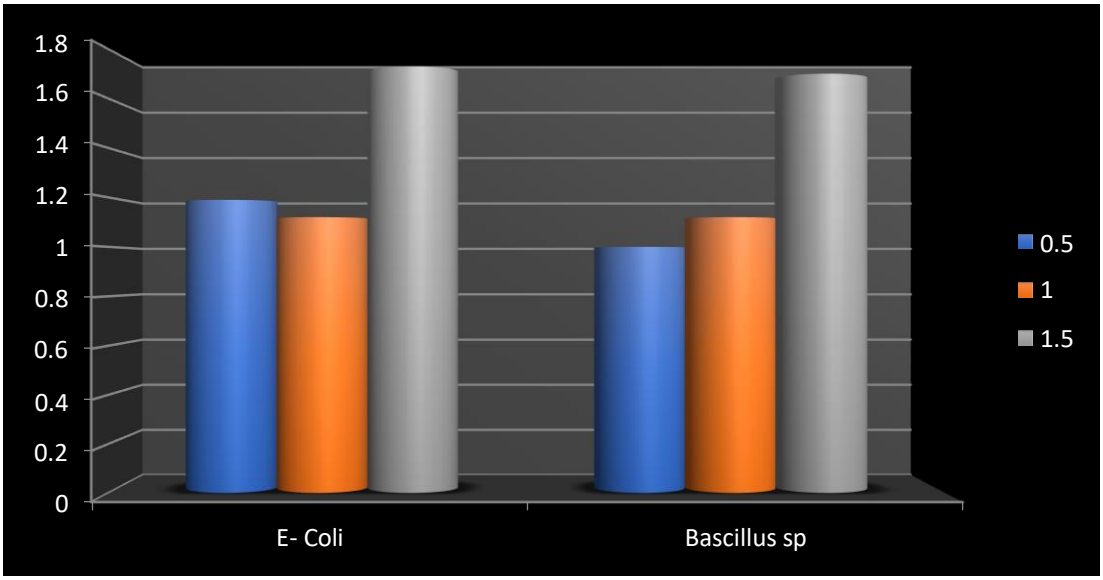


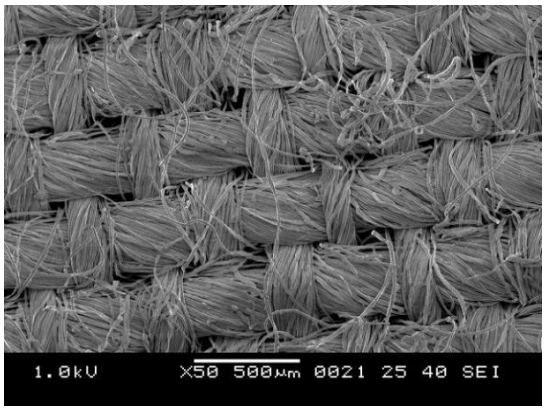
FIGURE 12
Antimicrobial Test

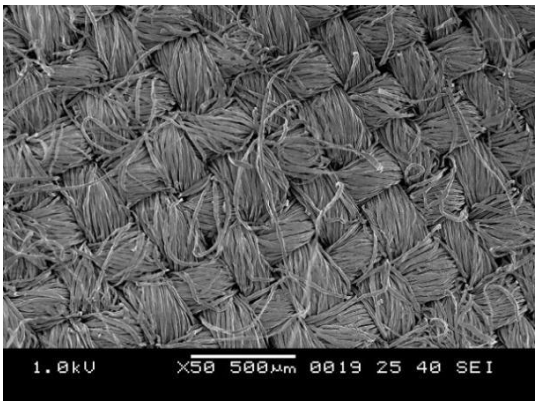
Table show prominent antimicrobial activity was observed by Orticle density value at 620 nanometre. Natural finished samples were subjected to antimicrobial assessment the species selected for the assessment were E-Coli and Bascillus sp. From the result, when the concentration increases the Microbial growth is decreases. However the results prove that the selected extract possesses good antimicrobial effect with 68 percent efficiency on comparison made with minimal concentration.

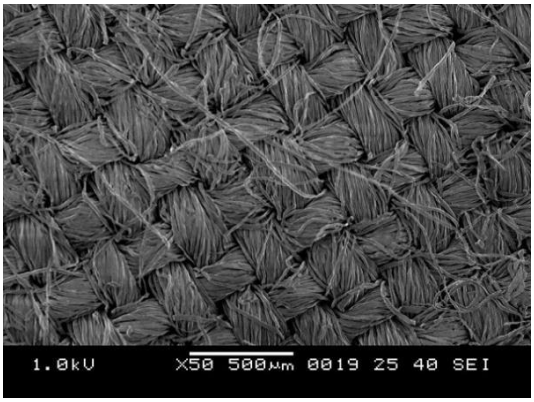
4.3 SEM APPEARANCE

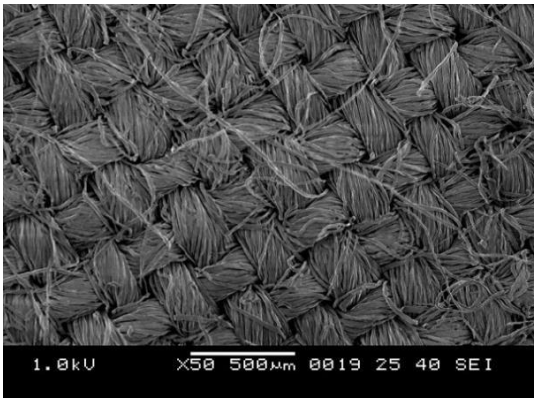
SEM micrographs of the treated and untreated samples depict significant change in the surface. Same etching and coating were absewed. This might be due to the finishing of fabric with natural extracts.

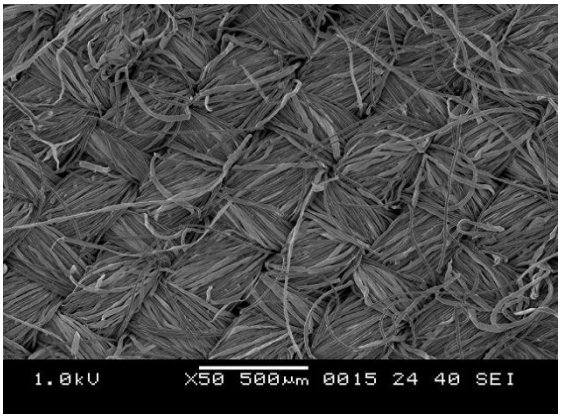
UTD Samples



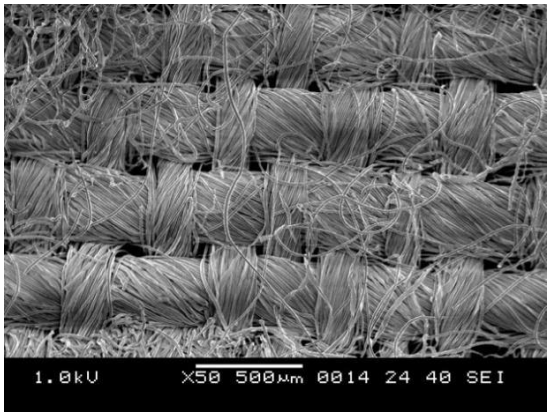








TRD Samples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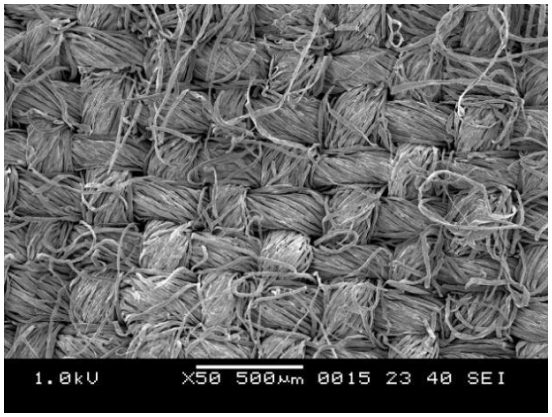
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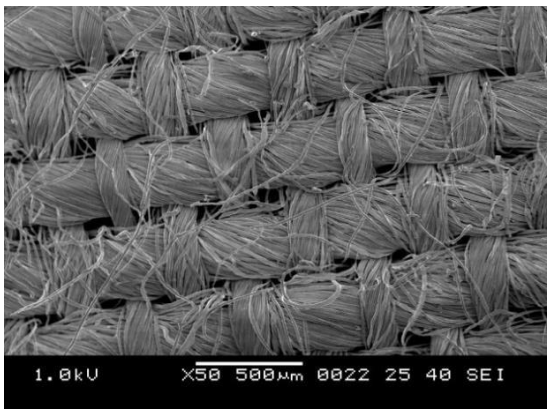
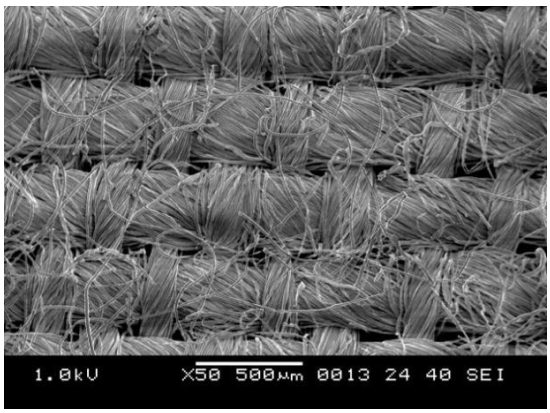

1.0kU X50 500µm 0022 25 40 SEI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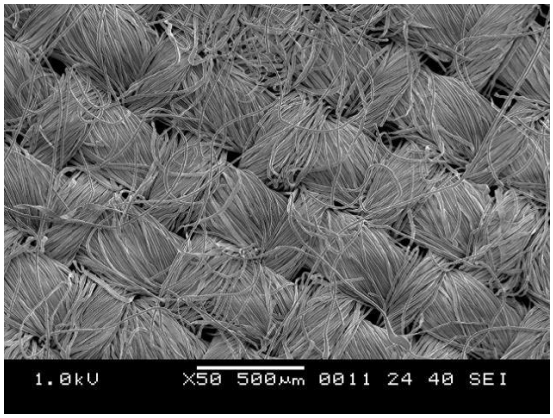
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4.4 UPF PROTECTION

The UPF Protection of the original mosquito repellent fabric was analyzed and the tested values are depicted in Table XVII and Figure 13.

TABLE XVII

UPF Test

S.NO	SAMPLE	NO. OF SCANS	UPF	UVA BLOCKING (%)	UVB BLOCKING (%)	UPF RATING
1	Untreated	5	11.27	92.23%	91.76%	11
2	Treated	5	112.40	98.79%	99.19%	112

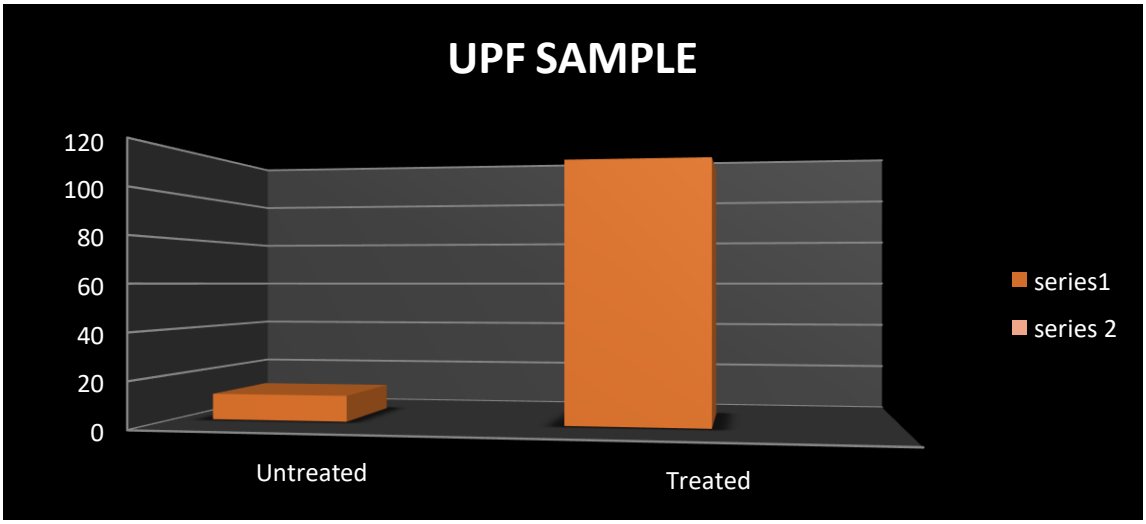

Figure 13

UPF Test

From Table XVIII Figure 11, it is clear that UV-A and UV-B blocking was found to increase in both the treated and untreated fabric. Cotton fabric finished with pelargonium extract showed Ultra Violet Protection Factor (UPF) rating as 112. UPF rating of original was reported to be 11.percent UV-B Blocking of finished sample were found to be 98.79 and 99.19 against 92.23 and 91.76 as shown by original sample. The extract finishing has an excellent UPF rating therefore , the finished fabric could be converted to sports textiles, caps, scarves, gloves, jackets and other outer wears. The treated fabric give an excellent result in the UPF protection.

5. SUMMARY AND CONCLUSION

Awareness about eco-friendliness in textiles is one of the important issues in recent times. Since textile are used to skin and is called second skin.owing to the demand of global consumer the researches are being carried out for new eco-friendly processes. Textile finishing is a process used in manufacturing of fibre, fabric or clothing. In order to impart the required functional properties to the fibre or fabric it is customary to subject the material to different type of physical and chemical treatment. Natural finishes comprises of those substance that are obtained from plants & animals. Natural finishes have many advantages such as non-toxic, non-irritant, easy availability etc. cotton is more absorbent it has good tensile strength , good absorbency & good affinity to dyes.

Finishing is the last stage of treatment given to a textile material mosquito repellent finish protects human being from mosquito bite there by promising safety from mosquito born dices malaria dengue fever (DF), Nile fever, Dengue hemorrhagic fever(DHF), Chicken quinoa & fill arias is.

Considering the above facts the investigator selected the research work on the topic **"Assessing the Functional properties of cotton fabric treated with *Geranium* leaf extract"** with the following objectives;

- To carry out natural extraction from pelargonium zonale.
- To finish the cotton fabric with the selected plant extract.
- To analyze the functional properties such as mosquito repellency, antimicrobial activity and UPF analysis.
- To evaluate the properties and SEM appearance of the finished cotton fabric.

EXPERIMENTAL PROCEDURE

The cotton fabric was selected for the study. In order to remove size , desizing was done. Geranium leaf was selected because of its good mosquito repellent property. To optimize the concentration and temperature for finishing on the fabric, pilot study was carried out. Material to liquor ratio of 1:10, 1:20, and 1:30 at 60°c respectively. For each of the parameters the cage test of mosquito repellent was tested and observed. Based on the result of pilot study concentration of the geranium extract with material liquor ratio of 1:10 was taken at 60°c and immersed the cotton fabric in the natural extract for 24 hours.

The fabric was objectively analyzed for thickness, weight, stiffness, tensile strength and elongation, crease recovery, wicking, sinking, and drop tests In addition, functional characteristics such as mosquito repellency, antimicrobial efficiency and UPF were analyzed. SEM analysis was also carried out to assess the surface modifications.

FINDINGS OF THE STUDY

The pre- treated and and finished fabric were evaluated subjectively and objectively.

- The fabric weight has increased when compared with original samples.
- The fabric thickness increased by in the finished sample when compared to the original sample. However after washing, thickness of the finished fabric decreased. The increase of fabric thickness is due to the finishing using natural extract.
- Stiffness of the fabric increased in all treated fabric in both warp and weft direction. Finishing with selected natural extract has enhanced the comfort property of fabric.
- The crease recovery increased in the fabric after finishing along warp direction and reduced in weft direction. Natural finishing has enhanced the crease recovery angle and hence the comfort property is improved.
- Wicking property in after finishing, the time has increased by 9.78 and 10.77 per cent among the sample MRT1 and MRT2. Finishing with natural extract has not affected the absorbency property of the fabric.
- The sinking time has increased by 9.16 and 1.04 among the sample both treated samples. Finishing with natural extract has not affected the absorbency property of the fabric.
- The treated samples before and after washing could absorb a droplet of water within 10.38(MRT1) and 10.60(MRT2) seconds while original fabric took 11.58 second. It can be inferred that finishing has enhanced the absorbency property of the fabric
- SEM image depicts the natural extract coating on the cotton fabric. The natural extract finished cotton fabric possess antimicrobial property when tested against .
- UPF protection gives a excellent result.

CONCLUSION

Plant based extracts have been widely used in textile finishing owning to their functional properties. Each plant has one or more functionalities. Present investigation carried out with pelargonium extract finishing on cotton fabric was found to be effective as it possess mosquito repellent, antimicrobial property & UPF. Among these unwanted treated sample was more effective for mosquito repellent than the washed sample. However finishing can be replenished and used . As for as antimicrobial property is concerned ,the treated fabric has antimicrobial efficiency against pelargonium and hence could be explored further to convert

into a medical textile product. UPF test result proved the excellent UPF rating and UV Blocking A and B. Therefore the pelargonium extract finished cotton fabric could be used as jackets, sports textile, caps, scarves,gloves and other outer wears.

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WEBSITE:

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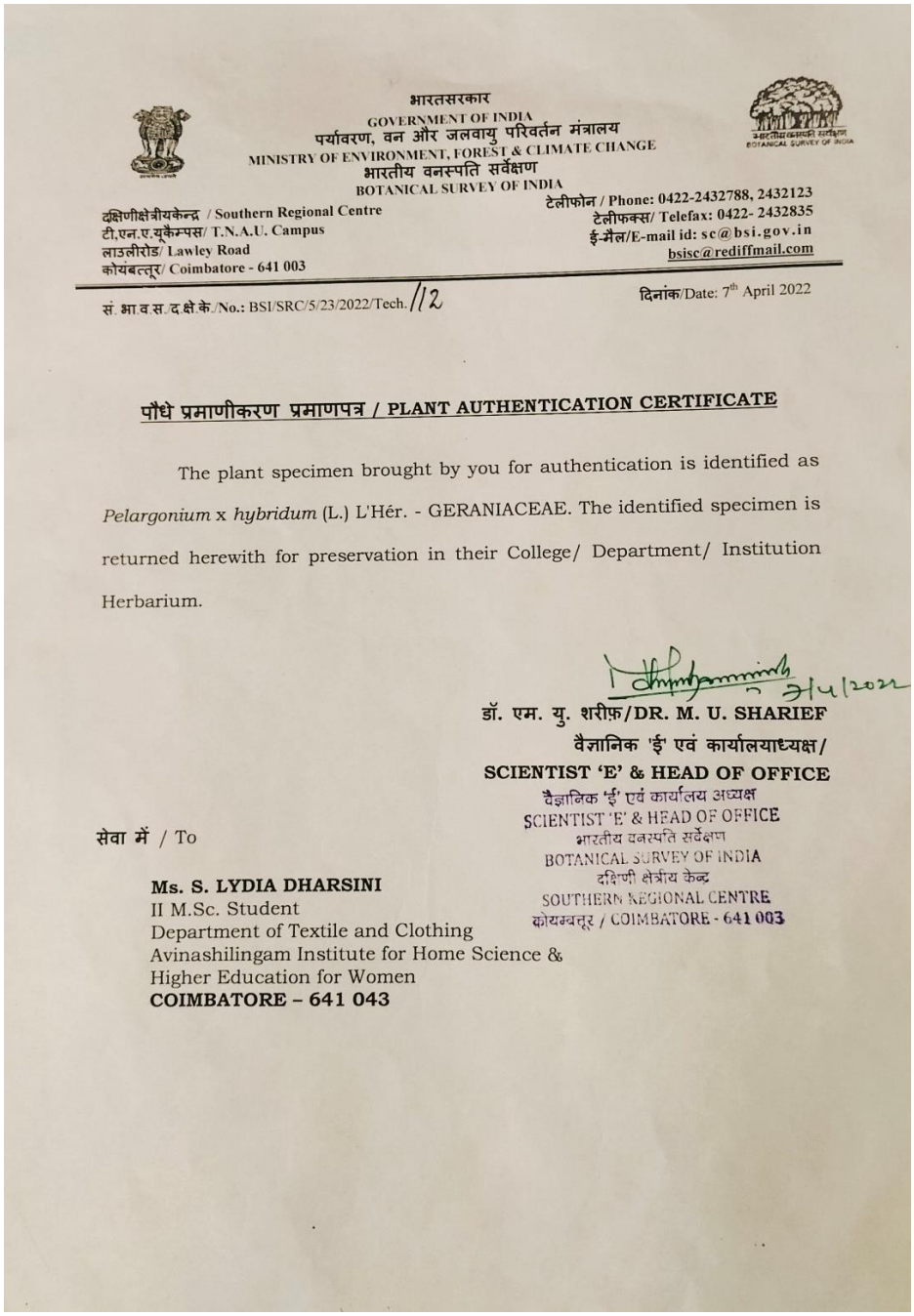
APPENDIX 1



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सं. भा.व.स.द.क्षे.के./No.: BSI/SRC/5/23/2022/Tech./12

दिनांक/Date: 7th April 2022

पौधे प्रमाणीकरण प्रमाणपत्र / PLANT AUTHENTICATION CERTIFICATE

The plant specimen brought by you for authentication is identified as *Pelargonium* x *hybridum* (L.) L'Hér. - GERANIACEAE. The identified specimen is returned herewith for preservation in their College/ Department/ Institution Herbarium.

7/4/2022

डॉ. एम. यु. शरीफ़/DR. M. U. SHARIEF
वैज्ञानिक 'ई' एवं कार्यालयाध्यक्ष/
SCIENTIST 'E' & HEAD OF OFFICE
वैज्ञानिक 'ई' एवं कार्यालय अध्यक्ष
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सेवा में / To

Ms. S. LYDIA DHARSINI
II M.Sc. Student
Department of Textile and Clothing
Avinashilingam Institute for Home Science &
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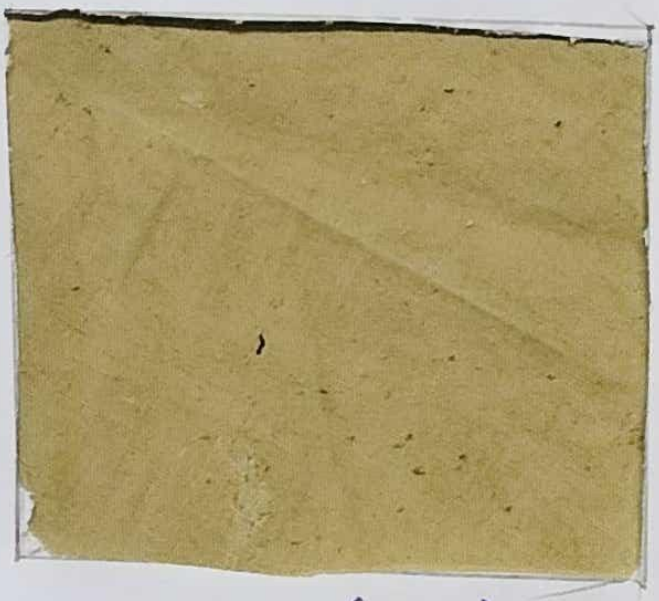
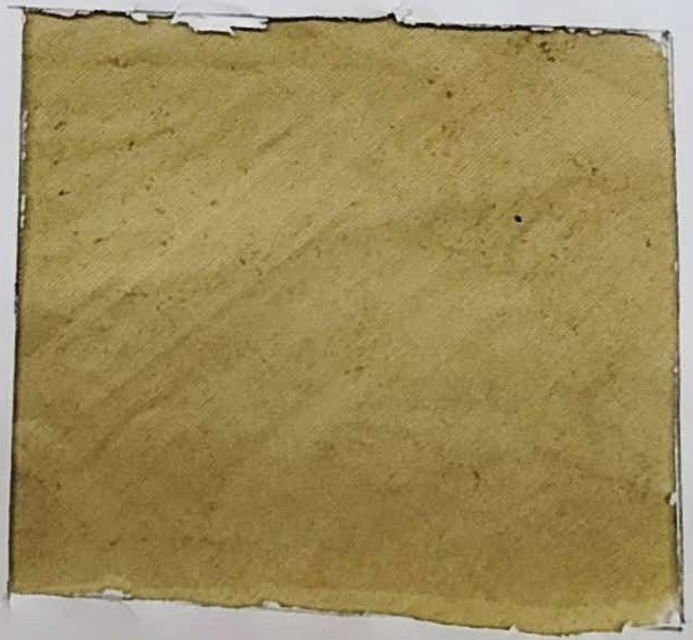
APPENDIX 2

APPENDIX 2

ORIGINAL FABRIC



MRT - 1 (Before Wash)



MRT- 2 (After Wash)