A STUDY ON THE ANTIMICROBIAL PROPERTY OF THE COTTON FABRIC FINISHED WITH *Tridax procumbens* LEAF EXTRACT

SHANMATHI.S

(17PTF019)

A Thesis Submitted To The

Avinashilingam Institute for Home Science and

Higher Education for Women

Coimbatore-641 043

In partial fulfillment of the requirement for the degree of

MASTER OF SCIENCE IN TEXTILES AND FASHION APPAREL

April 2019

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Certified as Bonafide Research Work

Signature of the

Head of the Department

Signature of the Supervisor

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1. INTRODUCTION

A textile is a flexible material consisting of a network of natural or artificial fibres. The word “textile” was originally used to define a woven fabric and the process involved in weaving. Textiles refers to any material made of interlacing fibres or yarns. Textiles are formed by weaving , knitting, crocheting, knotting or pressing fibres. The production of textiles is a craft whose speed and scale of production has been altered almost beyond recognition by industrialization and the introduction of modern manufacturing technique (Vidhyasagar,2004). The textiles are not only the carrier but also a good media for the growth of micro organisms. Cotton fibre is the purest source of cellulose and the most significant natural fibre. The strength of cotton fibre is attributed to the rigidity of cellulosic chains. The fibre properties determines the market value of the cotton. Cotton accounts for the bulk of the raw material used in the very large short staple spun yarn market(Gordon,2006)

Textiles are made in various strengths and degree of durability, from the finest microfiber made of strands thinner than one denier to the sturdiest canvas. The fabrics have long been recognized as a good support medium for the growth of microbes. A microbe on textile causes unwanted effects to both the wearer and the textile itself. The protective aspects, mainly rely on the presence of the microorganisms the effects they cause on the fabric. The microbes have resulted in the development of innovative and hygienic finishes on the textiles. The consumers also demand for the hygienic,clothing which has created production of antimicrobial textile products. Antimicrobial finish prevents the growth of bacteria thereby protects and prevent diseases(Rajendran,2016) Antimicrobial agents includes silver nanoparticles, phenols, chitosan and plant based chemicals.

Antimicrobial functions on textiles span from inhibiting growth of microorganism to inactivating pathogens rapidly. In addition to the power of antimicrobial functions on textile products, the durability of the function is a tough challenge especially the washing and storage durability.

Textiles have intimate contact with the human skin and the antimicrobial agents on the surfaces of the textiles could cause skin irritation and sensitization reactions bringing human safety concerns (Gang sun,2016). There is a great demand

for eco friendly antimicrobial finish on textiles. The finishing of the natural compounds would be a good alternative for the synthetic antimicrobial agents. The major problem associated with the herbal antimicrobial finishing is that they are not durable. The development of antimicrobial textiles has been the one of the most active and important research area in recent years.

Tridax procumbens is commonly known as coat buttons. It is an well known Ayurvedic, ethino-botanical and unani medicinal plant. Pharmacological studies have shown that *Tridax procumbens* possess properties like anti inflammatory, hepatoprotective, wound healing, antimicrobial, antiseptic, hypotensive and bradycardiac effects. The plant was reported to treat various ailments such as dysentery, diarrhoea and preventing hair loss. These properties are mainly due to many active phytochemicals including the presence of carbohydrates, proteins, tannins, steroids, alkaloids, and glycosides. It is used in India for wound healing, as an anticoagulant, antifungal and insect repellent. It is used in Ayurvedic medicine for liver disorders, hepatoprotection, gastritis and heartburn. The juice extracted from the leaves is directly applied on wounds. It is also used in treatment of boils, blisters and cuts by local healers. The flavonoid procumbenetin has been isolated from the plant. The other chemical compounds present in the plant includes alkyl esters, sterols, pentacyclic triterpenes, fatty acids and polysaccharides.

Hence the present study " A STUDY ON THE ANTIMICROBIAL PROPERTY OF THE COTTON FABRIC FINISHED WITH *Tridax procumbens* LEAF EXTRACT is carried out with the following objectives.

- To assess the Phytochemical components present in the Ethyl acetate, Ethanol and Chloroform extracts of *Tridax procumbens*
- To study the efficacy of extraction medium to extract herbal solution from *Tridax procumbens* for Antibacterial activity.
- To evaluate the antibacterial activity of *Tridax procumbens* finished fabric.

2. REVIEW OF LITREATURE

2.1 Natural source

In the present study, the natural source is selected as Tridax procumbens listed as a weed and a pest plant, of Family Asteraceae is found perennially in waste places, road sides and hedges throughout India. It has been known by several names including Tridax daisy in English, Jayanthi veda in Sanskrit, Gharma in hindi, Dagadi pala in Marathi, Herbe caile in French and Thata poodu in tamil. It was reported that in some tribal area of India, the leaf juice can be used to cure fresh wounds, stop bleeding and also used as a hair tonic.(www.wikipedia.com). Traditionally it is used for the treatment of bronchial catarrh, dysentery, malaria, stomach ache, diarrhoea, high blood pressure and to check haemorrhage from cuts, bruises and wounds to prevent falling of hair. It possess antiseptic, insecticidal, parasiticidal and hepatoprotective properties and has marked depressant action on respiration(www.org.com)

Scientific classification:

Kingdom : Plantae

Order : Asterales

Family: Asteraceae

Tribe : Heliantheae

Genus : Tridax

Species : T.procumbens

T.procumbens has a very saponin content. It is known to reduce the uptake of certain nutrients like glucose and cholesterol and may help in lessening the metabolic burden. The tridax procumbens (Atish,2005)

2.2 Selection of fabric

2.2.1 Cotton

Cotton is the purest source of cellulose and the most significant natural fibre. Cotton fibers are composed mostly α-cellulose. The specific chemical composition of the

cotton fibers vary by their varieties. The primary cell walls of the cotton fibers contain less than 30% cellulose and it has lower molecular weight. The secondary wall of the cotton fibre is nearly 100% cellulose. The structure of the cotton fibers can be viewed along the fiber axis and across the fiber section. Cotton fibers are the largest single cells in nature. Some matured fibres can reach upto 4,000 times in length of their diameters. Both the fibre length and the secondary wall thickness are increased with higher potassium supply during growth. Drying of fibers involves the removal of fluids from the cellulose. The strength of the cotton fibers is attributed o the rigidity of the cellulosic chains, the highly fibrillar and crystalline structure.

2.2.2 History

Cotton is one of the oldest known fibre some of the earliest fabric relics found in excavations of ancient civilisations have been cotton.Archaeologists found cotton fabric 5000 years old at MohenjoDaro, an ancient town in the Indus river valley of west Pakistan, and similarly aged examples have been found in Egypt and in Mexico (Gienandt, 2006).

Although the cotton plant is thought to have initially grown wild in East Africa, it was first cultivated in the country now known as Pakistan where its early uses were as a textile for clothing, bindings for sandals and harnesses for elephants. The Greek historian, Herodotus (484 - 425 BC) wrote about a tree in Asia that bore cotton exceeding in goodness and beauty (Gienandt, 2006).

2.2.3 Cultivation

Successful cultivation of cotton requires a long frost-free period, plenty of sunshine, and a moderate rainfall, usually from 60 to 120 cm.soils usually need to br fairly heavy,although the level of nutrients does not need to be exceptional. In general, these conditions are met with the seasonally dried tropics and subtropics in the northern and southern hemispheres, but a large proportion of the cotton grown today is cultivated in areas with less rainfall that optain the water from irrigation. Production of the crop for a given year usually starts soon after harvesting the preciding autumn. Cotton is naturally a perennial but is grown as an annual to help control pests. Cotton can also be cultivated to have colors other than the yellowish off-white. Typical of modern

commercial cotton fibers. Naturally coloured cotton can come in red , green and several shades of brown.(wang 2009)

2.2.4 Competition from synthetic fibers

Era of manufactured fibers began with the devlopement of rayon in france in the 1980s. Rayon is derived from a natural cellulose and cannot be considered synthetic, but requires extensive processing in a manufacturing process, and led the less expensive replacement of more naturally derived materials. A succession of new synthetic fibers were introduced by the chemicals industry in the following decates. Acetate in fiber form was developed in 1924. Nylon, the first fiber synthesized entirely from petrochemicals, was introduced as a sewing thread by DuPont in 1936. Some garments were created from fabrics based on these fibers, such as womens hoissery from nylon, but it was not until the introduction of polyester into the fiber market place in the yearly 1950s that the market for cotton came under threat. The rapid uptake of polyester in the 1960s caused economic hardship in cotton-exporting economics. Cotton production required in the 1970 , but crashed to pre 1960 levels in thr yearly 1990s.(craig.,2006)

2.2.5 Characteristics

One of the inherent characteristics that makes cotton "king" among fibers and enhances consumers' appeal is its comfort characteristics. Comfort here does not refer to the psychological comfort but to the physiological comfort such as the moisture vapor transport rate (MVTR). The rate at which water vapor moves through a fabric plays an important role in determining the comfort as it influences the human perspiration and the cool/warmth feeling. Human body produces moisture in the form of perspiration, which should leave the microclimate between the skin and fabric before condensation to avoid clinging of fabric on to skin, keeping the fabric and skin surface dry(Riello Giorgio,2013)

When a fabric allows the transport of water vapor at a faster rate, it is said to be a breathable fabric. In other words, the faster a fabric breaths,the better is its comfort.This property has direct implication on the end use application,consumer appeal and sales value of the fabric. More importantly,in the case of cotton, its inherent characteristic is its comfort (Regan, 2006). By controlling the moisture vapor

transport properties of 100% cotton, it was possible to develop a wide range of performance apparel fabric for athletic activities (Anonymous,2002).

2.2.6 Types of cotton

There are several species of cotton that grows wild but they are not economically feasible. There are five types of cotton that are being grown commercially around the world. These types are egpytian, sea island, American prima, Asiatic and American upland.

2.2.6.1 Pima cotton

Pima is considered the finest cotton. As an extra-long staple(ESL) cotton, its long fibers make it extra soft and extra strong. Luxuriously smooth fabric that is resistant to fraying, tearing, pilling, wrinkling and fading. Only pima cotton verifies its fabric contains pure pima cotton for quality can be feel by touch.(Gordan,2007)

2.2.6.2 Upland cotton

Upland cotton is characterised by its relatively short cotton fibers, Upland is perfect for producing quality everyday product which everyone can afford. It is one of the most common type of cotton in the US, making up 95% of the cotton planted on the American soil.(Gupta Rekha,2000)

2.2.6.3 Egpytian cotton

Like pima cotton, Egyptian is an extra long staple cotton, making it equally exceptional in softness, vibrancy and performance. Egyptian cotton is grown in the hot dry climate of the nile river valley in Egypt. It is a cotton of exceptional quality.(Misha,2000)

2.2.6.4 Acala cotton

A special variety of cotton called San Joaquin Valley Acala which is among the highest quality upland cotton in the world. Acala cotton benefits from the ideal climate of the San Joaquin Valley and a longer growing season, which result in yield and results in finer product. Due to the irrigation requirements, Acala tends to be more expensive than other American grown upland cotton.(Uzaramma,2017)

2.2.7 Properties of cotton

Cotton holds its own place as a textile material because it has properties very different to those of other fibres. Fabrics containing cotton are comfortable to wear and have an aesthetic appearance. The hydrophilic character of cotton coupled with high fibre tenacity, easy care and rapid moisture absorption and desorption properties are some other factors that have led to the development of a wide variety of characteristic textiles ranging from apparel fabric through household furnishing to artist's canvas. Such substrates need to be subjected to various chemical treatments for value addition. Typical treatments, such as scouring, bleaching and biopolishing, aim at improving the absorbency, level of whiteness and surface properties of the aforesaid products (Armstrong Thomas,1962)

Conventional method of scouring cotton textiles under high temperature and alkaline conditions is associated with number of problems. Another approach used to produce specific finishing effect on cellulosic textiles is enzymatic scouring. In comparison with alkali scouring, it offers significant advantages including lower effluent generation,water pollution and quite good soft action. Hydrogen peroxide is a strong bleaching agent that destroys natural colouring pigments and imparts degree of whiteness. Biopolishing is the core technology developed for the removal of protruding fibre from cotton material, and it is an effective way to improve material softness, smoothness and fashionable appearance(Aspirin, 2008)

The cotton fibers are mainly made up of cellulose. Cellulose does not form unless temperature are over 70°F. The cotton fibers are attached to the seeds inside the boll of the plant. The length of these fibers is the main determining factor in the quality of the cotton. Staple lengths are made divided into short, medium and long.

- Comfortable: There are no surface characteristics of cotton that make it irritating to the human skin. Cotton feels good against skin; it has a soft hand.
- Hydrophilic: Cotton has a natural affinity for water- it attracts moisture away from your body.
- Moisture passes freely through cotton- aiding in evaporation and cooling.
- Good heat conductivity: Cotton allows heat to dissipate making it a wonderful fiber to maintain a comfortable sleeping temperature.

- Strong and abrasion resistance.
- The unfavourable attributes of cotton include its lack of resiliency(cotton tends to wrinkle)and its lack of luster.

2.2.8 Advantages of cotton

Cotton is soft and comfortable. It is hypoallergic and won't irritate sensitive skin or cause allergies. Cotton is all natural and doesn't contain chemicals. Cotton fabric are highly breathable and allow air circulation that discourages fungi from growing in dark , moist environments. Cotton is perfect for wearing in the summer, as it can easily absorb body moisture and keep you cool and comfortable in hot weather (Beckret Sven, 2014)

2.3 Extraction from herbal source

Extraction is the crucial first step in the analysis of medicinal plants because it is necessary to extract the desired chemical components from the plant material for separation. The basic operation includes steps, such as pre washing, drying of plant material of freeze drying, grinding to obtain homogeneous sample. The selection of solvent system largely depends on the specific nature of the bioactive compound. The extraction of hydrophilic compounds uses polar solvents such as methanol, ethanol or ethyl acetate.

2.4 Phytochemical screening

Phytochemicals are responsible for the medicinal activity of the plant. These are non nutritive chemicals that have protected human from various diseases. The major constituent consist of alkaloids, flavonoids, saponins, phenolic compounds, phytosterols, proteins and amino acids(Guvrav Naveen,2016). Phytochemicals constituents are the basic source for the establishment of several pharmaceutical industries playing a significant role in the identification of crude drugs. The anti inflammatory, antispasmodic, anti- analgesis and can be attributed to their high steroids, tanning, terpenoids and saponins. Chemical test were carried out on the extractions.

2.5 Antimicrobial agent for Textile

Antimicrobial agents are natural or synthetic compounds that inhibit the growth of microbes (bacteriostatic or fungistatic).(Fairbrother.R.W,2014) They inhibit protein or lipid synthesis or act as enzyme inhibitors, all of which are essential for cell survival or kill (biocidal) the microorganisms by causing damage to the cell wall(Baker syed,2002) Almost all antimicrobial synthetic agents in use on textile are biocides.

Several major classes of synthetic antimicrobial agents are used in textile industry and recent research is focused on natural compounds. They are in use in other industries, as food preservatives, disinfectants, etc.(Romeo Tony,2008) Antimicrobial agents should possess broad spectrum biocidal properties, be safe for use and highly effective against antibiotic resistant microorganisms including those that are commonly involved in hospital-acquired infections.(Ronald,2004) In addition, they should not permit the development of resistant microorganisms to the active compound or cause skin sensitization (Satyanarayanan,2012)

2.5.1 Synthetic antimicrobial compounds

Several antimicrobial agents have been tested in textiles (Quaternary ammonium compounds, silver,polyhexamethylenebiguanides (PHMB) and triclosan) even in an industrial scale.(Sebastian,2013)They have powerful bactericidal activity, as indicated by the MIC value. However, the majority have a reduced spectrum of microbial inhibition, and may cause skin irritation, ecotoxicity and bacterial resistance. Moreover, the biocide can gradually lose activity(Sonea Sorin,1983)during the use and launderings of the textile. Thus, great amounts of these biocides are applied to the textiles to control the bacterial growth efficiently and to keep its durability.(Steve Mould,2018)

In addition, despite the fact that synthetic antimicrobial agents used in textiles can be effective against a wide range of microorganisms, wearing these textile in a continuous manner can lead to sensitization and bacterial resistance (Ramachandran *et al* ., 2004).

2.5.2 Natural antimicrobial compounds

To minimize the risks associated with the application of synthetic antimicrobial agents, there is a great demand for antimicrobial textile based on non-toxic and ecofriendly bioactive compounds. The study on their use in textile is very limited and not well documented, except for the case of chitosan, natural dyes and natural plant extracts which has been widely reported (Andre,2005)

Natural bioactive compounds have been widely reported as antimicrobial agents for textile. Chitosan and plant extracts are the most explored. Yet, there are several major challenges regarding extraction, isolation of the bioactive compounds, application and durability(Dharmadurai.,2015) Nevertheless, due to their ecofriendly natural and non-toxic properties they are still promising candidates as antimicrobial agents for textiles(Dhanalakshmi.T,2006)

Chitosan

Chitosan is a deacetylated derivate of chitin, which is non toxic, resistant to microorganisms, biodegradable and biocompatible. The antimicrobial activity of chitosan is influenced by several factors such as the type of chitosan, the degree of deacetylation, molecular weight and other physical and chemical factors such as pH, ionic strength and addition of non-aqueous solvents.(David.A,2014)

Chitosan can be considered as an antimicrobial agent for textile finishing. However, its application in textile materials is effective against a wide range of microorganisms only at high concentration, which causes a decrease of the air permeability on fabric and turns the fabric very inflexible. Another disadvantage is the low durability after application(Riviere Cetine,2018)

Sericin

Sericin is a natural macromolecular protein derived from silkworm Bombyxmori which constitutes 25-30% of the silk protein.It is a biomolecule

of great value since it has antibacterial properties, UV resistance, resists oxidation and has hydrating properties.

It has several application, such as moisturizing agent in shampoos and cream, and is also an important biomaterial for various application including textiles. Although the application of sericin as an antibacterial agents for textiles has not been reported yet, it has been found evidence of such a potential application (Richard G,2007).

- **Neem**

Neem is an evergreen tree of India, which belongs to the plant family Meliaceae.This is recognized as one of the most promising sources of compounds with antimicrobial and medicinal properties. The active ingredients of neem are found in all parts of tree.

The extract of neem has been widely used in pesticide formulations. It has potential to inhibit the growth of gram- positive and gram-negative bacteria. At present, little has been reported of its use in textiles as an antimicrobial agent. Few studies concerning application of seed and bark extracts to cotton and cotton/polyester blends have been reported (Joshi *et al*., 2007).

- **Aloe vera**

Aloe vera belongs to the family Liliaceae and is known as "Life of the Desert". Research has shown that Aloe leaf contains a large number and variety of nutrients and active compounds. *Aloe vera* has antibacterial and antifungal activity Likewise to neem extracts, few studies havebeen reported and further investigation is needed.

- **Eucalyptus**

Eucalyptus oil has amazing cleaning properties.It is effective against infections caused by bacteria, fungi and viruses.But application in textile substrates is still being explored

- **Prickly chaff flower**

  Prickly chaff flower is one of the herbs most commonly found in India.It presents antimicrobial activity against both Gram-negative and Gram-positive bacteria, however with a low activity. It was tested in cotton fabric but the result showed mild antibacterial activity against Gram-negative bacteria.(Hunt Leslie,2015)

- **Clove oil**

  Clove oil is the main product of *Syzygiumaromaticum*.The bioactivity of clove oil was explored as an agent for finishing of cotton fabric but still, further investigation has to be done.(Mavers Douglas,2009)

2.6 Antibacterial activity test

The purpose of antibacterial test is that bacteria will lead to disease like food poisoning and allergy. With increasing demand for healthy life, many garments, furniture coverings and accessories with antibacterial property are produced. The function of suppressing the incubation of bacteria can be named as antibacterial property.

[TESTING METHOD- JIS L 1902-]

Absorption method – Quantitative test

This is the most basic method of determination of antibacterial activity and also in coincidence with two standards. Compare the number of colonies or ATP amount on the surface of the antibacterial finished samples and control fabric after incubating under same condition for same time. The result will be judged according to bacteriostatic activity value and bactericidal activity value.

3.METHODOLOGY

The methodology of the present study exhibited **" A STUDY ON THE ANTIMICROBIAL PROPERTY OF THE COTTON FABRIC FINISHED WITH *Tridax procumbens* LEAF EXTRACT** " is discussed under the following headings:

3.1 Preparation of herbal extracts from the selected source

3.1.1 Selection of source

3.1.2 Extraction of the source

3.2 Phytochemical analysis of different extracts of *Tridax procumbens*

3.3 Selection of fabric

3.3.1 Pre treatment of the fabric

3.3.2 Desizing of cotton

3.4 Herbal Finishing by pad dry cure method

3.5 Evaluation of antibacterial activity

3.5.1 Parallel streak plate method

3.6 Selection of bacterial species

3.7 Evaluation of the finished fabrics

3.7.1 Objective analysis

3.7.1.1 Fabric weight

3.7.1.3 Fabric thickness

3.7.1.4 Fabric stiffness

3.7.1.5 Tensile strength and elongation

3.7.1.6 Drop test

3.7.1.6 Fabric wicking and sinking test

3.7.1.7 Wash durability test

3.1Preparation of Herbal extracts from the selected source

3.1.1 Selection of source

In the present study, *Tridax procumbens* leaf was selected as the natural antibacterial source. The leaf juice was used to cure fresh wounds, stop bleeding and also used as a hair tonic. It is known to reduce the uptake of certain nutrients like glucose and cholesterol and may help in lessening the metabolic burden. It possess antiseptic, insecticidal, parasiticidal and hepatoprotective properties and has marked depressant action on respiration(Ikewuchi.*et,al*.,2009). Based on the literature *Tridax procumbens* was selected as antibacterial agent for the present study.

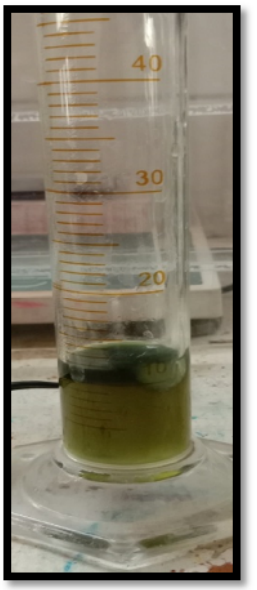
(Plate 1) TRIDAX PROCUMBER

3.1.2 Extraction of source

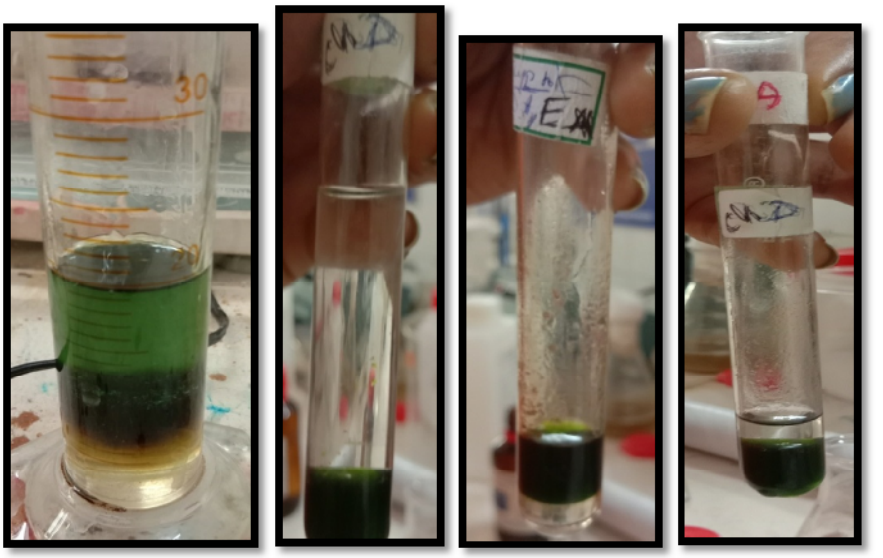
Fresh leaves of *Tridax procumbens* leaves were shadow dried at room temperature. The dried leaves were ground into fine powder by mechanical grinding. The fine powder obtained after grinding was used for the extraction. About 20 grams of the dried leaf powder was weighed and added into different flasks containing 100 ml of solvents (ethanol, ethyl acetate, chloroform) each and kept for 48 hours. The extract was filtered using the filter paper. The extract was then used for the determination of Anti bacterial activity.

3.2 Phytochemical analysis of different extracts of *Tridax procumbens*

Phytochemicals are responsible for the medicinal activity of the plant. These are non nutritive chemicals that have protected human from various diseases. The major constituent consist of alkaloids, flavonoids, saponins, phenolic compounds, phytosterols, proteins and amino acids. The different extracts were subjected to the phytochemical evaluation

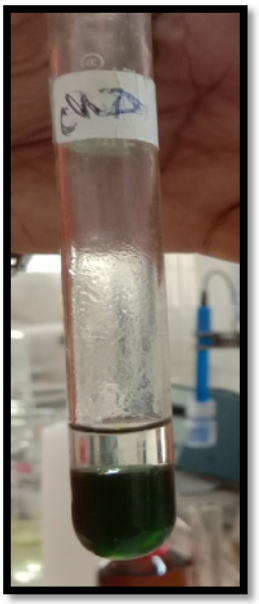


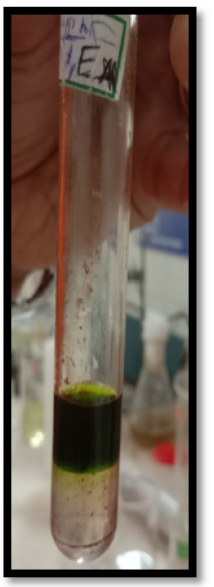
(Plate 2)ALKALOIDS



(Plate 3) **(Plate 3)** **(Plate 4)**

SAPONINS **QUINONES** **PHENOLIC COMPOUNDS**





(Plate 6) **(Plate 7)** **(Plate 8)**

STEROIDS **FLAVONOIDS** **TERPINOIDS**

3.2.1 Test for steroids

2 ml of the extract was taken in the test tube. 2 ml of chloroform was poured into the extract and then 5 ml of the sulphuric acid was added at the sides of the test tubes. There was a colour change which appears on the extract. When the upper layer becomes red and later it turns into yellow colour it indicates the presence of steroids.

3.2.2 Test for saponins

2 ml of the extract was taken in the test tube and later 6 ml of distilled water was poured in it. The presence of foam indicates the presence of saponins.

3.2.3 Test for Terpenoids

2 ml of extract was taken in the test tube and 2 ml of acetic anhydride was added to the extract. There is a formation of blue, green or red colour this indicates the presence of Terpenoids.

3.2.4 Test for Quinones

1 ml of the extract was taken in the test tube and 2 ml of dilute NaOH was added to it. The colour changes into blue, green and red which indicates the presence of quinones.

3.2.5 Test for Tannins

2 ml of the extract was taken in test tube and 10% of alcoholic ferric chloride solution was added to it. There is an appearance of blue greenish colour indicates the presence of Tannins.

3.2.6 Test for Phenolic compounds

2 ml of the extract was taken in the test tube. 5% of aqueous ferric chloride was added to it. If the colour changes into blue greenish colour it indicates the presence of Phenolic compounds.

3.2.7 Test for Flavoids

2 ml of the extract was taken in test tube. 1 ml of sodium hydroxide solution was added to it the colour changes into intense yellow colour. It indicates the presence of flavoids.

3.2.8 Test for Alkaloids

2 ml of the extract was taken in the test tube and 2 ml of mayers reagent was added to it. There is an appearance of white creamy colour. It indicates the presence of Alkaloids.

3.3 Selection of fabric

Cotton is a natural fibre . The hydrophilic character of cotton coupled with high fibre tenacity, easy care and rapid moisture absorption and desorption properties are some other factors that have led to the development of a wide variety of characteristic textiles ranging from apparel fabric through household furnishing to artist's canvas. It is hypoallergic and won't irritate sensitive skin or cause allergies. Cotton is all natural and doesn't contain chemicals. Cotton fabric are highly breathable and allow air circulation that discourages fungi from growing in dark , moist environments.

(Plate 9) COTTON FABRIC

3.3.1 Preparatory process

3.3.2 Desizing of cotton

Desizing is an essential stage,in which the sizing particles are removed from the fabric. Desizing was carried out with solution containing 2g/1 of non ionic detergent for 1 hour. The desized material was thoroughly washed with tap water and dried at room temperature.

3.3.3 Bleaching of cotton

After desizing, the material was used for bleaching. The bleaching process is carried with the help of hydrogen per oxide. The material was boiled for 1 hour along with hydrogen per oxide solution. Then it is rinsed with cold water for about 3 to 5 times, then the fabric was allowed to dry.

3.4 Herbal Finishing by pad dry cure method

Finishing is done by padding mangle machine. 200 ml of herbal source was taken and poured into the trough which holds the solution. Rough cloth was stitched to one end of the fabric. The stitched cloth is placed between two rollers and machine was switched on. The fabric starts to pass through the roller and the fabric was dipped in the solution.The excess amount was squeezed out. When the fabric passes between the rollers. The same procedure was carried out 3-5 times to get even finishing. After

finishing the fabric was allowed to dry for 30 minutes. After drying, the fabric was weighed and evaluated for antibacterial activity.

(Plate 10) FINISHED FABRICS

(Plate 11) PADDING MANGLE

3.5 Evaluation of Antibacterial activity

The finished samples were subjected to antibacterial assessment by parallel streak plate method.

3.5.1 Parallel streak plate method

The parallel streak plate method (AATCC 147-2004)executed qualitative method to determine the antibacterial activity on the treated fabrics. A piece of treated

fabric is pressed onto an agar plate and the test bacteria are inoculated over the specimen by three or four parallel streaks.

3.5.2 Preparation of nutrient agar

Nutrient agar is used as a general purpose medium for the growth of wide variety of non- fastidious microorganism. It consist of peptone, beef extract and agar. Nutrient agar is used in the cultivation and maintenance of non fastidious organism as well as enumeration of organisms in water, sewage, dairy products, feces and other materials. Composition of nutrient agar

Beef extract…….3.0 g

Peptone……5.0 g

Agar……15.0 g

Distilled water……..1000 ml

Final pH……....6.8+/-0.2

Dissolve the dehydrated medium in the appropriate volume of distilled water. Heat with frequent agitation and boil for 1 minute to completely dissolve the powder. Sterilize the medium by autoclaving(121°C for 15 min). Dispense the medium in to tubes or plates. Left the agar medium to solidify and store. Determine the pH of the medium with pH meter and adjust if necessary.

3.6 Selection of Bacterial species

Escherichia coli also known as E .*coli* is a gram negative, facultative anaerobic, rod shaped, coliform bacterium that is commonly on the lower intestine of the warm blooded organisms. It is versatile host for the production of heterologous proteins. Hence E.*coli* was selected as the representation of gram negative bacteria.

Bacillus subtilis is a Gram positive bacteria found in soil and the gastrointestinal tract of ruminants and humans. It is one of the bacterial champions in secreted enzyme production and used on an industrial scale by biotechnology companies. Due to its excellent fermentation properties, with high product yield it is

used to produce various enzymes, such as amylase and proteases. Hence *Bacillus subtilis* was selected as the representation of gram positive bacteria.

3.7 Evaluation of finished fabrics

Textile testing is the tests used to examine and assess the properties of textiles. The faults or the defects can be easily determined. The finished sample was subjected for the objective evaluation.

3.7.1 Objective Evaluation

3.7.1.1 Fabric weight

Fabric weight as the relative weight of the fabric and expressed as the weight of a particular size of piece as gram / square meter or ounces / square yard. Fabric weight of the original and dyed sample was determined using GSM cutter. It is a device to cut circular specimen of 100 square centimetres of a fabric very accurately. It has four blades that cut the fabric, when the hand wheel is rotated by applying light pressure. The samples were cut and weighted accurately using digital balance having 0.01 sensitivity. The value in grams multiplied by 100 gives / square meter of the fabric.

The samples were weighted for five times and the mean value was calculated and recorded.

3.7.1.2 Fabric Thickness

Fabric Thickness is defined as the distance between lower and upper surface of the material measured under a standard pressure, using Shirley Thickness Tester with an accuracy of 0.01 mm. Fabric thickness gauge are used to measure thickness of the sample. .It has two parts of anvil and pressure foot. Pressure was given at the foot to make the gauge zero. The samples was placed between the cleaned pressure foot and anvil. The reading shown by the dial was noted. For each samples at five different places away from two inches of the selvedge.

3.7.1.3 Fabric stiffness

Fabric stiffness indicates the resistance of the fabric to bending and it is a key factor in the study of handle and drape. Fabric Stiffness Tester was used to test the

stiffness of the fabric. Samples A was cut to the size of 15 cm x 2.5 cm using the template. The sample was placed on the platform with the template at the top of it, so that the leading edges coincide. Both were slowly pushed forward until the leading edges of the samples and template project beyond the edges of the platform. The sliding of the sample was stopped when it cut both the index lines. Then the bending length of the sample read from the scale opposite a datum line engraved on the side platform. Five readings were taken.

3.7.1.4 Tensile strength and Elongation

Breaking strength is the measure of resistance of the fabric to a tensile load or stress in both warp and weft direction. Elongation measures the extent of deformation along the axis of a material under a tensile and expressed in units of length of the fabric when loaded. The original and dyed fabric were tested for tensile strength using Eureka Cloth Strength Tester. 12 inches x 12 inches specimen from each samples were cut in both warp direction of the fabric, 2inches apart from selvedge. The specimen was placed between the upper and lower clamp. The dial reading was set to zero by adjusting the pendulum zero. Before starting the machine the pendulum lock was released and the machine was stated to run. A certain point the fabric starts to break, the machine was switched off and the dial reading in lb was taken.

Elongation reading was noted from the elongation scale. The specimen was removed and the machine positioned back to original and the five specimens of both directions from each samples were testing and readings were noted.

3.7.1.5 Drop test

Drop test is designed by ASTM test method TS-018 procedure of absorbency to to measure the water absorbency of textiles by measuring the time it takes a drop of water placed on the fabric surface to be completely absorbed into the fabric. Sample is placed over the top of a beaker so that the centre is unsupported. A measure drop of water is placed on the fabric 1cm from the surface. Time is recorded until the water drop absorbs completely.

3.7.1.6 Fabric wicking and sinking test

The wicking test was conducted as per the procedure as per the procedure. A strip of fabric (3o cm × 2cm) was suspended vertically with an edge in reservoir of distilled water was then moisture. To detect the position of water line a days was added to the water ability to absorb water.

The sinking test is a sample test that helps to measure the wet ability of the fabric about to sample were cut into a small square specimen about 1×1 is at the cheap. The surface is absorbed the time is greater than the wet ability.

3.7.1.7 Wash durability test for finished fabric

The durability of finishing is one of the main factor. The durability of the finished sample was evaluated after several wash cycles. The treated samples were washed with 5% neutral soap solution for 20 min keeping the material liquor ratio at 1: 50 followed by rinsing, washing and drying according to the laundry test AATCC 124 method. The washed samples were tested after 5, 10 launderings.

TABLE 1

NOMENCLATURE OF THE SAMPLE

SAMPLE	NOMENCLATURE
EAS	Ethyl acetate sample
CS	Choloroform sample
ES	Ethanol sample

4. RESULT AND DISCUSSION

The results of the present study entitled "A STUDY ON THE ANTIMICROBIAL PROPERTY OF THE COTTON FABRIC FINISHED WITH *Tridax procumbens* LEAF EXTRACT " are discussed under the following headings

4.1 PHYTOCHEMICALS ANALYSIS

4.2 ANTIBACTERIAL ACTIVITY

4.3 FABRIC WEIGHT

4.4 FABRIC THICKNESS

4.5 FABRIC STIFFNESS

4.6 TENSILE STRENGTH AND ELONGATION

4.7 FABRIC WICKING AND SINKING TEST

4.8 DROP TEST

4.9 WASH DURABILITY OF FINISHED SAMPLE

4.1 Phytochemical analysis of *Tridax procumbens* extract

The phytochemical analysis of *Tridax procumbens* extract which the preliminary test for the antimicrobial activity was carried out and the results are presented in Table 1

TABLE 1I

PHYTOCHEMICAL ANALYSIS OF *Tridax procumbens* EXTRACT

	ETHANOLIC EXTRACT	ETHYL ACETATE EXTRACT	CHLOROFORM EXTRACT
Steroids	✓	✓	✓
Saponins	✓	✓	✓
Terpenoids	✓	✓	✓
Quinones	✓	✓	✓
Phenolic compounds	✓	✓	✓
Flavonoids	✓	✓	✓
Alkaloids	✓	✓	✓

The three different herbal extracts such as Ethanolic extract, ethyl acetate extract and chloroform extract were subjected to phytochemical evaluation. From Table 1 it is clear that all the three extracts contains the Phytochemical compounds steroids, saponins, Terpenoids, quinines, phenols, flavonoids, alkaloids may be responsible for the antibacterial activity.

4.2 Antibacterial activity

Zone of inhibition formed against *E.coli* and *Bacillus subtilis* for finished samples are presented in Table 2

Table III

Antibacterial activity

S.No	Antibacterial Activity	Zone of inhibition (mm) Test organisms	
		E.coli	***Bacillus subtilis***
1	Ethyl acetate extract dyed sample	29	25
2	Chloroform extract dyed sample	20	23
3	Ethanol extract dyed sample	22	24

Ethyl acetate extract dyed sample showed zone of inhibition of 5mm against E.coli followed by chloroform extract dyed sample. Chloroform extract dyed sample showed zone of inhibition 7 mm against Bacillus subtilis followed by Ethanol extract dyed sample.

4.3 Fabric weight

The fabric weight and analysis of variance of the samples EAS, CS, ES are shown in Table 2 and Figure 1

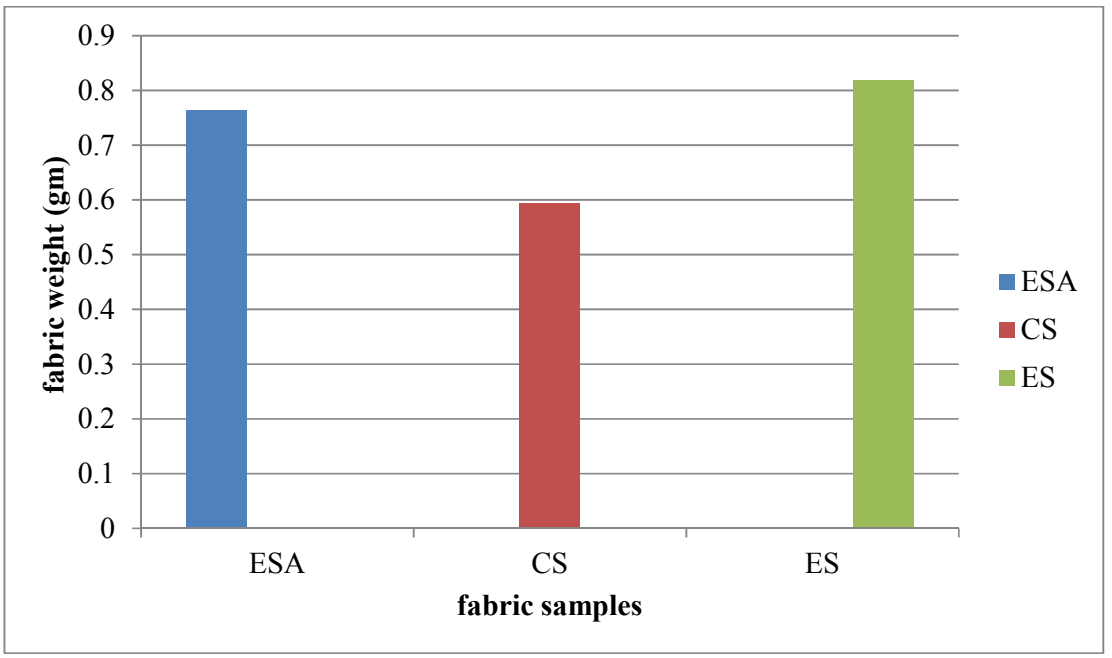
TABLE IV

Fabric weight

S.NO	SAMPLE	MEAN VALUE(GSM)	LOSS (OR) GAIN OVER ORIGINAL	% LOSS OR GAIN OVER ORIGINAL
1	EAS	0.765	0.657	8.0
2	CS	0.675	0.595	7.10
3	ES	0.790	0.820	6.8

FIGURE 1

Fabric weight



Among the finished samples, fabric weight was found to be highest in sample finished with ethanol sample followed by ethyl acetate extract dyed sample

4.4 Fabric Thickness

The fabric thickness and analysis of variance of the samples EAS, CS, ES are shown in Table 3 and Figure 2

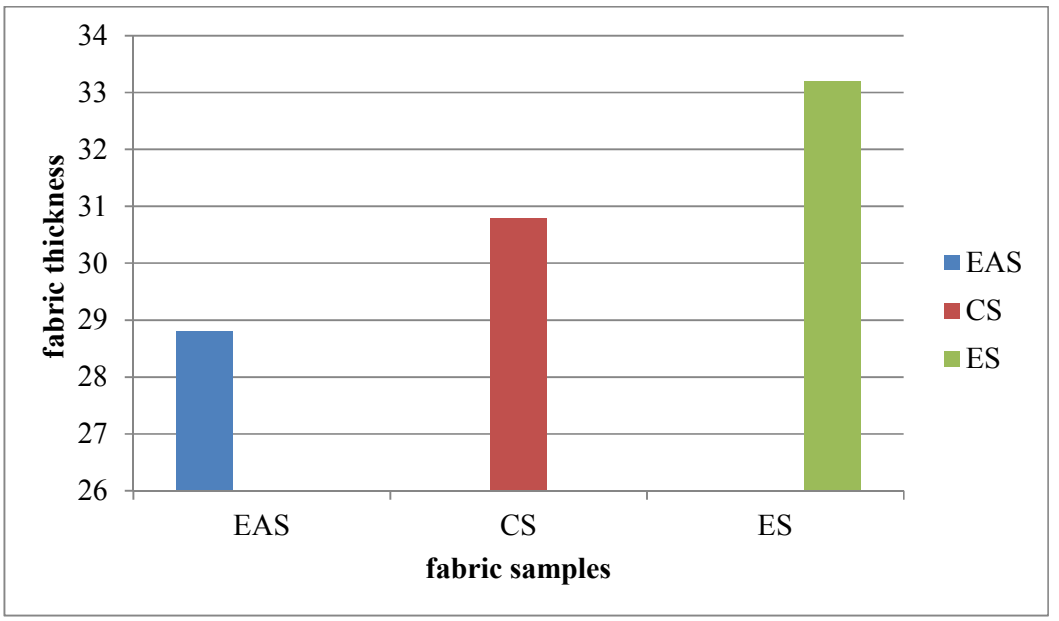
TABLE V

Fabric thickness

S.No.	Sample	Mean value (mm)	Loss or gain Over original	% loss or gain over original
1	EAS	28.800	1.5	4.0
2	CS	30.800	2	6.9
3	ES	33.200	4.4	7.5

FIGURE 2

Fabric thickness



Among the finished samples, fabric thickness was found to be highest in sample finished with ethanol sample followed by chloroform extract finished sample

4.5 Fabric stiffness

The fabric stiffness of the different samples in both the warp and the weft directions are shown in the Table 4 and 5 and Figure 3 and 4.

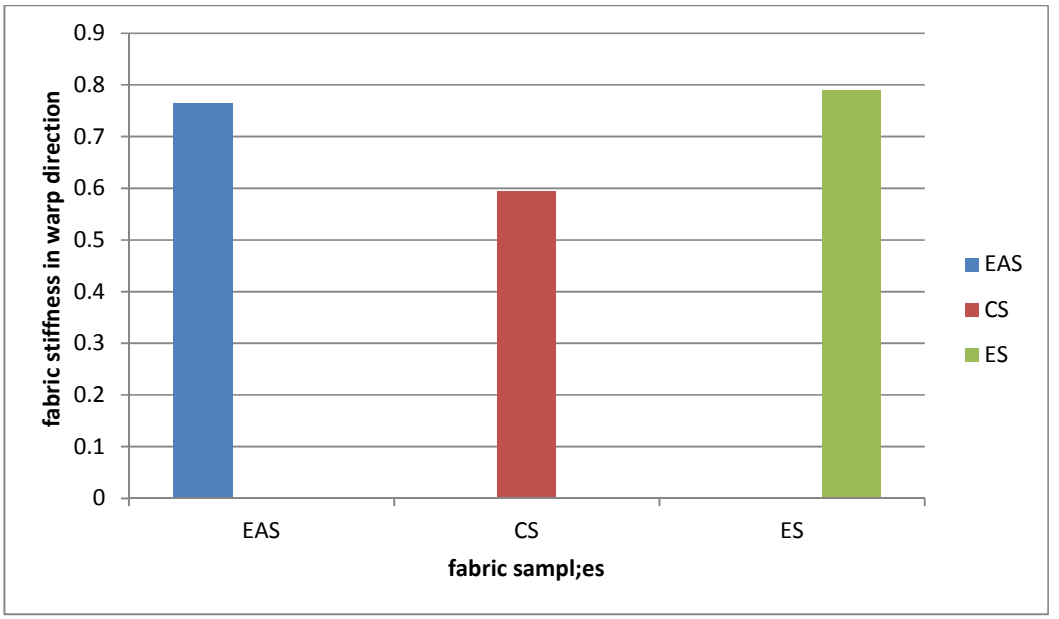
TABLE VI

Fabric stiffness in warp direction

S.NO	SAMPLE	MEAN VALUE	LOSS (OR) GAIN OVER ORIGINAL	% LOSS OR GAIN OVER ORIGINAL
1	EAS	0.765	0.657	8.0
2	CS	0.675	0.595	7.10
3	ES	0.790	0.820	6.8

FIGURE 3

Fabric stiffness in warp direction



Among the finished samples, fabric stiffness in warp direction is found to be highest in sample finished with ethanol sample followed by ethyl acetate extract finished sample.

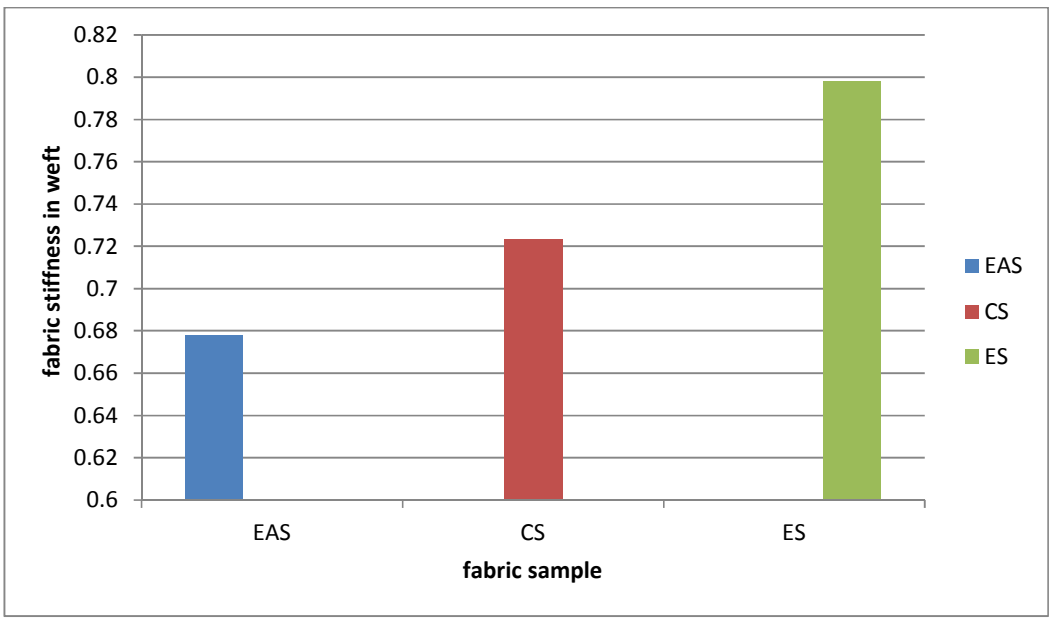
TABLE VII

Fabric stiffness in weft direction

S.NO	SAMPLE	MEAN VALUE	LOSS (OR) GAIN OVER ORIGINAL	% LOSS OR GAIN OVER ORIGINAL
1	EAS	0.765	0.657	4.5
2	CS	0.675	0.595	7.3
3	ES	0.790	0.820	6.3

FIGURE 4

Fabric stiffness in weft direction



Among the finished samples, fabric stiffness in weft direction was found to be highest in sample finished with Ethanol followed by chloroform extract finished sample.

4.6 Fabric dry strength and elongation in weft

Fabric dry strength and elongation and analysis of the samples in weft direction are shown in the Table-6

TABLE VIII

Fabric dry strength and elongation in weft

S.NO	STRENGTH(kg)	ELONGATION VALUE	ELONGATION%
1	17	1.2	12
2	13	1.5	15
3	15	1.4	14

AVERAGE = 15 kg AVERAGE = 13.6 kg

Strength of the dry fabric in weft direction = 15kg

Elongation of the dry fabric in the weft direction = 13.6%

FIGURE 5

Fabric dry strength and elongation in weft

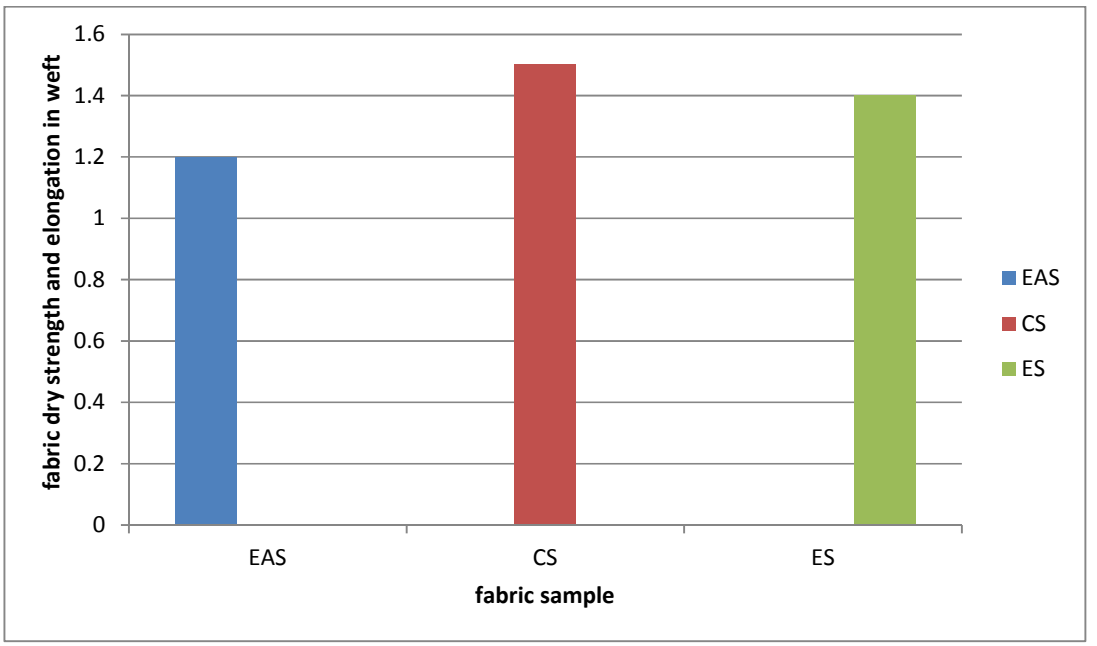


TABLE VIII (a)

Fabric dry strength and elongation in warp

S.NO	STRENGTH(kg)	ELONGATION VALUE	ELONGATION%
1	20	1.7	17
2	22	1.6	16
3	21	2.0	20

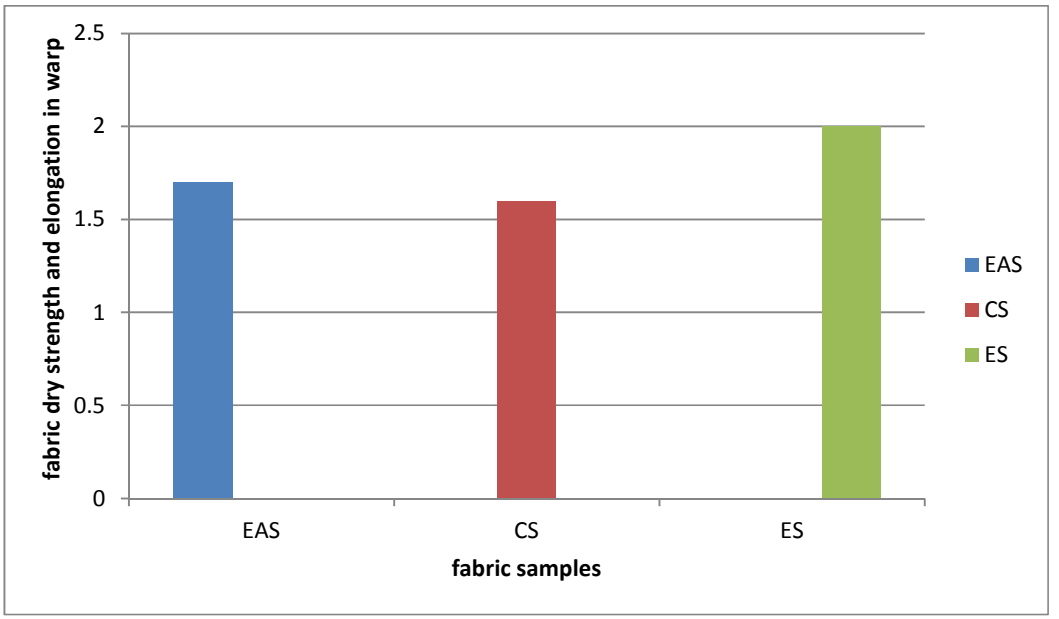
AVERAGE = 21 kg AVERAGE = 17 .6%

Strength of dry fabric in warp direction = 21 kg

Elongation of dry fabric in warp direction = 17.6%

FIGURE 6

Fabric dry strength and elongation in warp direction



Among the finished samples, fabric dry strength was found to be highest in sample finished with chloroform sample in weft followed by ethanol extract finished sample in warp.

TABLE VIII(b)

Fabric wet strength and elongation in warp direction

S.NO	STRENGTH(kg)	ELONGATION VALUE	ELONGATION%
1	21	2.0	20
2	23	1.8	18
3	25	1.9	19

AVERAGE = 23 kg AVERAGE = 19.2%

Strength of wet fabric in warp direction = 23kg

Elongation of wet fabric in warp direction = 19.2%

FIGURE 7

Fabric wet strength and elongation in warp direction

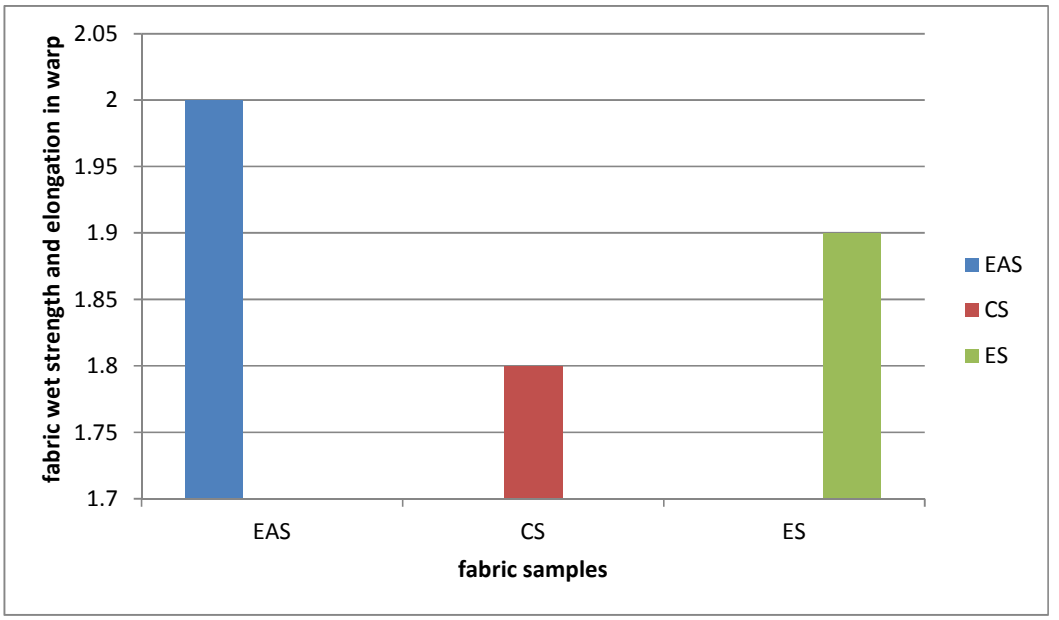


TABLE VIII(c)

Fabric wet strength and elongation in weft direction

S.NO	STRENGTH	ELONGATION VALUE	ELONGATION%
1	17	1.3	13
2	20	1.2	12
3	16	1.5	15

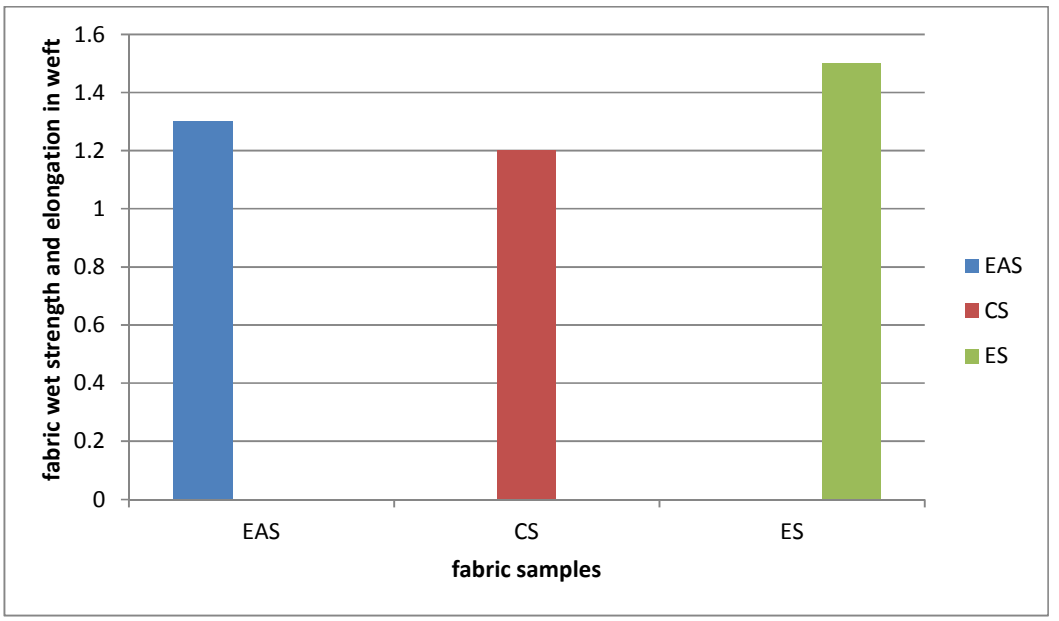
AVERAGE = 17 kg AVERAGE = 13.3%

Strength of wet fabric in weft direction = 17 kg

Elongation of wet fabric in weft direction = 13.3%

FIGURE 8

Fabric wet strength and elongation in weft direction



Among the finished samples fabric wet strength was found to be highest in the sample finished with ethyl acetate sample in warp followed by ethanol sample in weft.

4.7 WICKING TEST

Wicking test and the analysis of the variance of the sample EAS, CS and ES are shown in Table 7

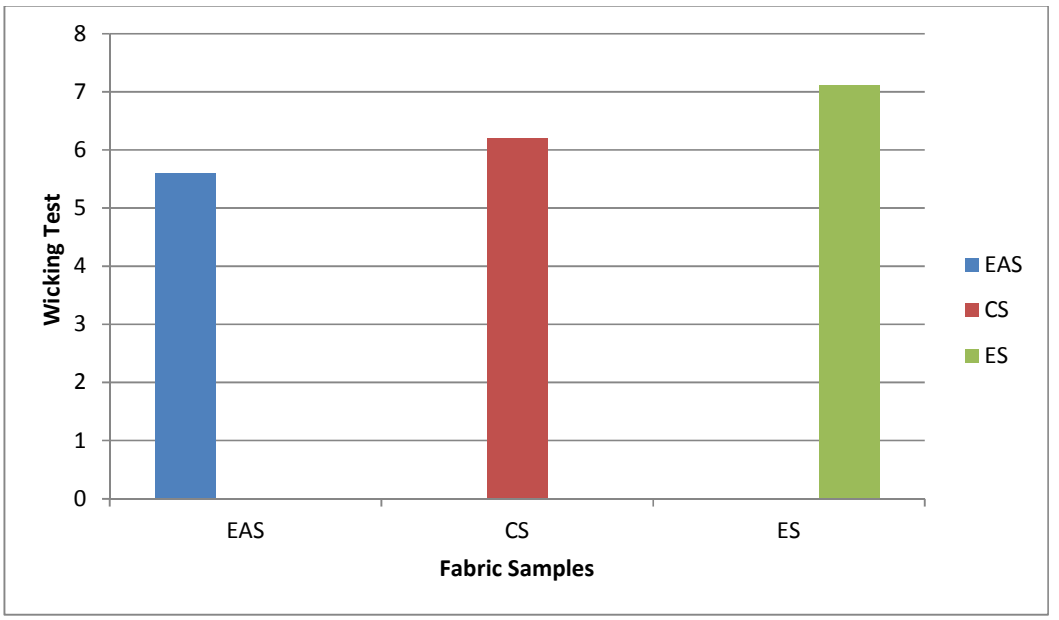
TABLE IX

WICKING TEST

S.No.	Sample	Mean value (Gsm)	Loss or gain Over original	% loss or gain over original
1	EAS	5.6	0.8	23
2	CS	6.2	1.5	30
3	ES	7.1	2.0	33.89

FIGURE 9

WICKING TEST



Time taken for the fabric to be absorbed was found to be decreased in all the finished samples among the finished samples that time taken to absorb the water is minimum in ethyl acetate sample.

4.7.1 SINKING TEST

Sinking test and the analysis of the variance of the sample EAS,CS and ES are shown in Table 8

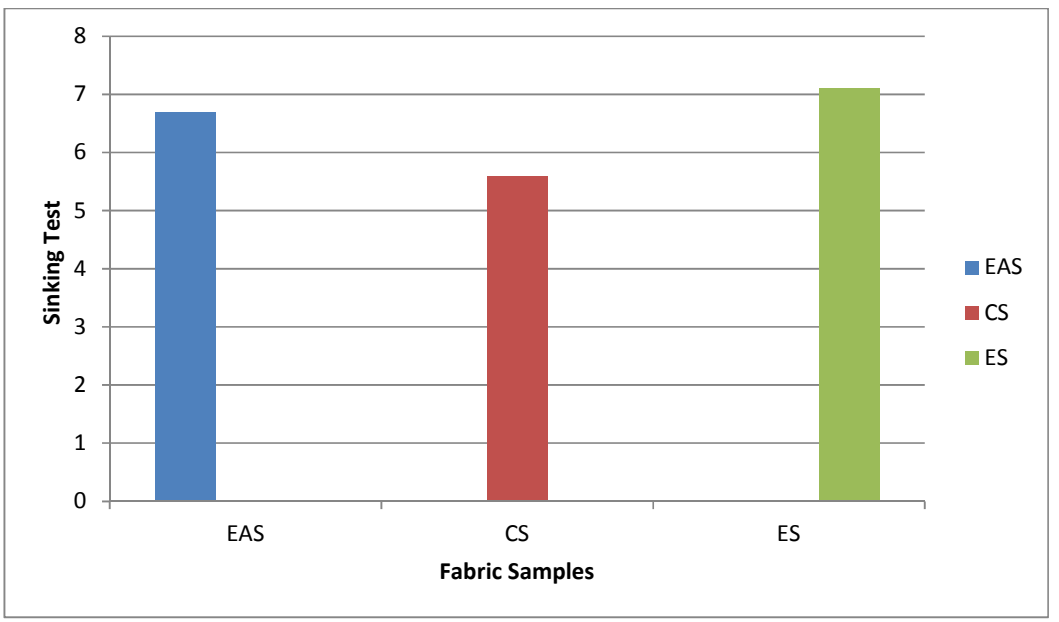
TABLE X

SINKING TEST

S.No.	Sample	Mean value (Gsm)	Loss or gain Over original	% loss or gain over original
1	EAS	6.7	1.9	21.8
2	CS	5.6	2.0	23
3	ES	7.1	1.7	20.5

FIGURE 10

SINKING TEST



Time taken for the fabric to sink was found to be decreased in all the finished samples among the finished samples the time taken to sink is minimum in chloroform sample.

4. 8 Drop test

Drop test and the analysis of the variance of the samples OC, CDC and PDC are shown in Table and Figure.

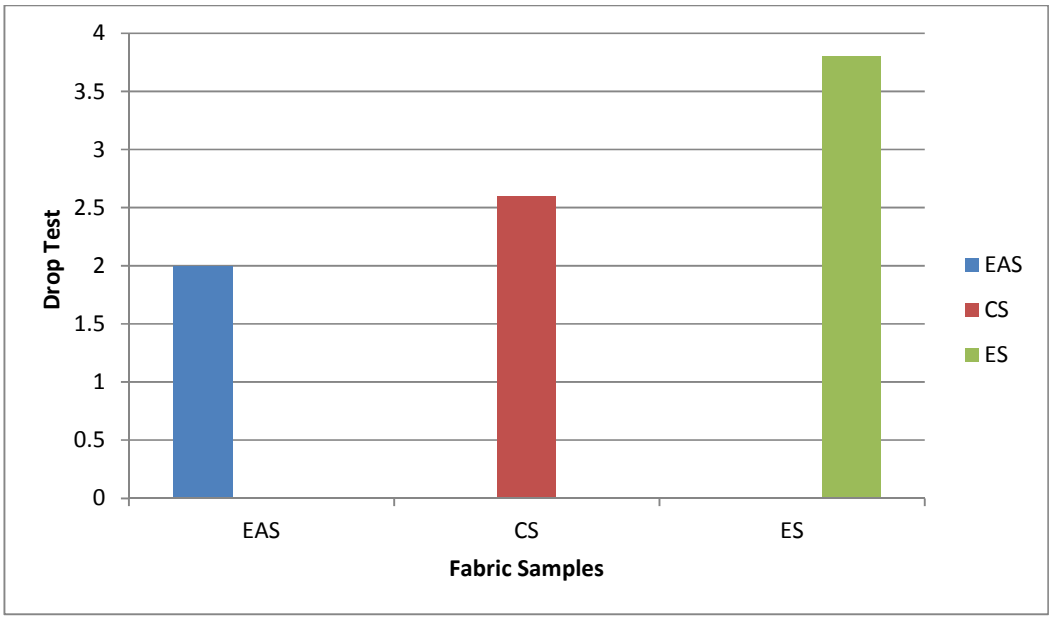
TABLE XI

DROP TEST

S.No.	Sample	Mean value (sec)	Loss or gain Over original	% loss or gain over original
1	EAS	2.000	1.5	68
2	CS	2.600	0.6	30
3	ES	3.800	1.4	60

FIGURE 11

DROP TEST



Time taken for a drop to be absorbed was found to be decreased in all the finished samples. Among the finished samples the time taken to absorb a drop of water is minimum in ethyl acetate sample.

4.9 WASH DURABILITY TEST FOR FINISHED SAMPLE

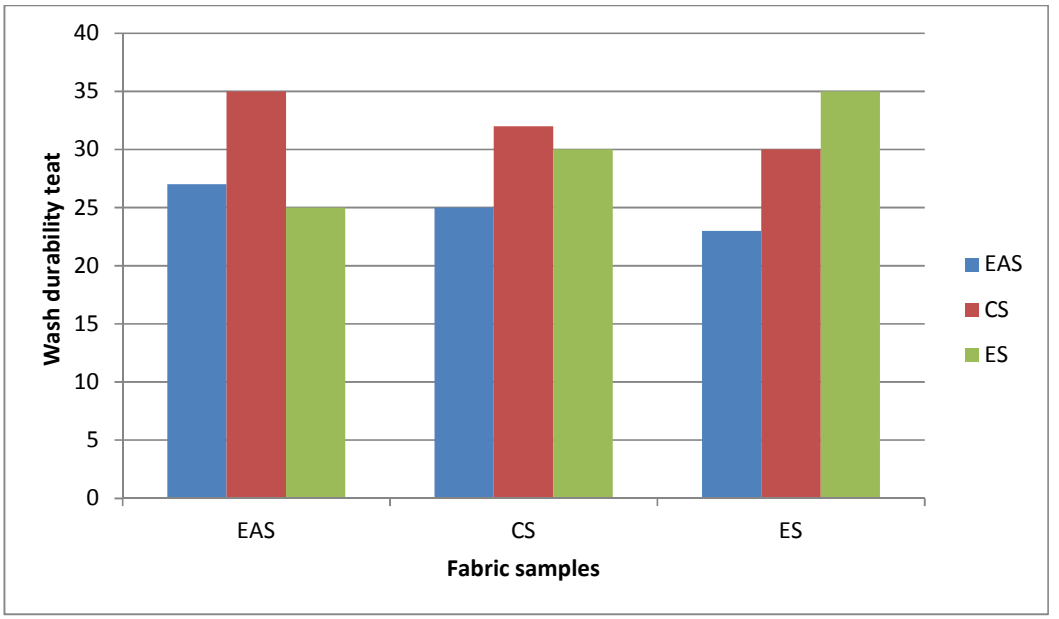
The anti bacterial activity of the finished sample was assessed against E.coli and Bacillus Subtilis after 5 and 10 washes and the results are presented in the table 10

TABLE XII

S.NO	SAMPLE	NUMBER OF WASHES			
		5	10	5	10
1	EAS	27	35	22	24
2	CS	25	32	26	22
3	ES	23	30	23	20

FIGURE 12

WASH DURABILITY TEST FOR FINISHED SAMPLE



Ethyl acetate extract finished sample retained maximum anti bacterial activity 23 mm against E.coli even after 10 washes. Ethanol extract finished sample retained maximum anti bacterial activity 21 mm against Bacillus Subtilis even after 10 washes.

5. SUMMARY AND CONCLUSION

Textiles have intimate contact with the human skin and the antimicrobial agents on the surfaces of the textiles could cause skin irritation and sensitization reactions bringing human safety concerns. There is a great demand for eco friendly antimicrobial finish on textiles. The finishing of the natural compounds would be a good alternative for the synthetic antimicrobial agents. The protective aspects, mainly rely on the presence of the microorganisms and the effects they cause on the fabric. Presence of microbes have resulted in the development of innovative and hygienic finishes on the textiles.

In the present study, *Tridax procumbens* have been chosen as natural antibacterial agent. The chemical components present in the plant includes alkyl esters, sterols, pentacyclic triterpenes and fatty acids. It is used in India for wound healing and as antifungal , insect repellent agent. *Tridax procumbens* possess properties like anti inflammatory, wound healing, antimicrobial and hypotensive activity.

Hence the present study " A STUDY ON THE ANTIMICROBIAL PROPERTY OF THE COTTON FABRIC FINISHED WITH *Tridax procumbens* LEAF EXTRACT is carried out with the following objectives.

- To assess the Phytochemical components present in the Ethyl acetate, Ethanol and Chloroform extracts of *Tridax procumbens*.
- To study the efficacy of extraction medium to extract herbal solution from *Tridax procumbens* for Antibacterial activit
- To evaluate the antibacterial activity of *Tridax procumbens* finished fabric

METHODOLOGY

- Herbal solution was extracted from *Tridax procumbens* leaves using different solvents (ethyl acetate, ethanol and chloroform).
- The selected cotton fabric is finished by pad dry cure method.
- The herbal solution extracted using different solvents were subjected to Phytochemical analysis.

- Antibacterial activity

  Parallel streak method was used to determine the antibacterial activity of the herbal extract finished fabrics against Gram negative bacteria *E.coli* and Gram positive bacteria *Bacillus subtilis* were selected for the antibacterial test.

FINDINGS

- Ethanol is found to be the suitable solvent for the extraction.
- The results of objective evaluation of finished fabric revealed that the sample finished using padding mangle was rated excellent in appearance, brighter in shade and evenly dyed.
- The fabric weight was found to be increased in all the samples with maximum increase in the sample EAS.
- The fabric thickness was found to be increased in all the samples with maximum thickness in ES sample
- The fabric stiffness was found to be increased in all the sample with maximum stiffness in CS sample.
- The dry strength and elongation of the fabric was increased in warp direction and the wet strength and elongation of the fabric is increased in weft direction
- Absorbency was found to be higher in the sample ES when compared to other samples.
- With regard to wash durability, sample ES was found to exhibit antibacterial activity even after 15 washes.

CONCLUSION

. The result of present work confirms that, *Tridax procumbens* can be utilized as a antibacterial agent. These herb can be grown through out India. The herb is easily available and hence can be used for providing antibacterial finish for fabrics.

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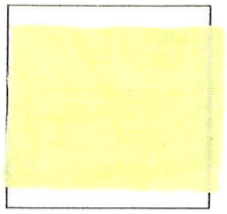
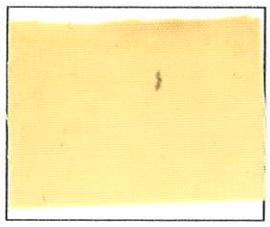
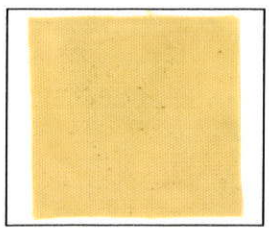
Fabric samples



Finished fabric of ethylacetate



Finished fabric of choloroform



Finished fabric of ethanol