Comparative Study on Antimicrobial Property of *Annona Squamosa L.* Leaves and Seeds

Deepa, M
(12PTF004)

Thesis Submitted to
Avinashilingam Institute for Home Science and Higher Education for Women,
Coimbatore - 641 043.

In Partial Fulfillment of the Requirements for The Degree of Master of Science in textiles and Fashion Apparel

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Signature of the
Supervisor

signature of the
Head of the deportment

ACKNOWLEDGEMENT

First, the investigator likes to say that she would not have been able to compute this without the ever-evident presence of **GOD ALMIGHTY** with her. The god gave the courage, wisdom, desertion knowledge, strength, opportunity and will power to keep going all the trying times she had during the course of her project.

The investigator expresses her reverential gratitude to **Hon. Colonel Thiru. T.S.AVINASHILINGAM**, Founder and First Chancellor of Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, University for providing the temple of learning and also for his heavenly blessings. She also owes her deep sense of gratitude to **Hon. Colonel padmashree Dr. (Tmt.) RAJAMMAL P.DEVADAS,** Former Chancellor, Avinashilingam Institute for Home Science and Higher Education for Women, University, Coimbatore, for blessing.

The investigator expresses her immense gratitude and thankfulness to **Thiru.T.K.S.MEENASKSHI SUNDHARAM M.A., M.Phil., Ph.D.** Chancellor, Avinashilingam Institute for Home Science and Higher Education for Women, University, Coimbatore, for his constant support and providing the required infrastructure for caring out the study.

The investigator wishes to extend her sincere thanks to **Dr. (Tmt.) SHEELA RAMACHANDRAN M.Sc, PG.Dip., Ph.D**. Vice Chancellor, Avinashilingam Institute for Home Science and Higher Education for Women, University, Coimbatore, for her ever-ending motivation and encouragement.

The investigator extends her pleasure and sincere thanks to **Dr. (Tmt.) GOWRI RAMAKRISHNAN, M.Sc, M.Phil., Ph.D.** Registrar, Avinashilingam Institute for Home Science and Higher Education for Women, University, Coimbatore, for providing facilities during the study.

The investigator greatfully acknowledges heartfelt thanks to her beloved Director, Halls of Residence, **Dr (Tmt) SAROJA PRABHAKARAN, M.A., Dip.Ed., Ph.D.,** Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, for providing all the facilities, love and care for the successful completion of the study.

She express her respectful regards and sincere thanks to **Dr (Tmt) U.K.Lakshmi, M.Sc., Dip.Ed., M.Phil., Ph.D.,** Dean, Faculty of Home Science and Professor and Head of the Department of Food Science and Nutrition, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, for rendering all help needed for the successful completion of the study.

The investigator is extremely obliged and thankful to **Dr. (Tmt.) N.VASUGI RAJAA M.Sc, MBA., M.Phil., Ph.D.** Professor and Head , Department of Textiles and clothing, Avinashilingam Institute for Home Science and Higher Education for Women, University, Coimbatore, for her encouragement given during the study.

With great sense of the truthfulness the investigator submit her heartfelt thanks to her guide **R. PRABHA M.Sc** ,Assistant Professor, Department Of Textiles And Clothing, Avinashilingam Institute for Home Science and Higher Education for Women, University, Coimbatore, for her great enthusiasm, inspiration, suggestions, continuous encouragement, patience and valuable ideas to complete her study successfully.

Out of deep sense of indebtedness, the investigator expresses her sincere thanks to **all the staff members and students of the Textiles and Clothing Department** who helped her with their constructive suggestions at all times

She is thankful to Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, University **South Indian Textile Research Association** (SITRA) And **South Indian Mills Association** (SIMA), for providing the library facilities.

Above all, the investigator wish to record her deep senses of gratitude to all over her beloved parents, **Thiru.p.Muthu and Tmt.M.Valarmathi**, Sister, brother-in-low Relatives and Friends and their motivation, moral support, encouragement and constant prayers rendered during the study period.

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1. INTRODUCTION

The textile industry is one of the nation's oldest and dynamic segments of an entire manufacturing industry (Nadaraj, 2008). Textile industries in India are the backbone of the national economy. It is the largest industry in India occupying a vital role in the Indian economy and occupies a unique place in the country. It accounts for 14 percent of the total exports and is the second largest employment generator after agriculture. (Ail *et.al*, 2006). Due to increasing requirements on the finishing of textile fabrics, increasing use of technical textiles that have been processed by environmentally sound methods, new innovative production techniques are demanded (Rain *et.al*, 2007).

Cotton has been grown and used to make fabrics in ancient China, Egypt, India, Peru and Mexico and today is one of the most important and widely used fibers worldwide. It grows in any part of the world with or temperature to hot climate, long growing seasons and adequate rain (Stauffer, 2004). One of the main advantages of cotton is its resistance to alkali solution and the mild alkali solution and mild alkalis like sodium carbonate have no action on cotton in the absence of air either at low temperature. However, in the presence of oxygen or air, cellulose is formed with graduated tendering of cotton (Mishra *et.al*, 2000). The most commonly encountered natural fiber is cotton, but the widespread use of white cotton fibers also has various characteristics microscopic features, and appear flat and spiraled or twisted under the microscope. Their fibers can be dyed with a wide range of dyes and because of their convoluted structure; transfer easily during contact (Clark *et al.,* 2006).

Cotton is a seed fiber, attached to the seed of the cotton plant. It has been used for 5,000 years, and is the 2nd most widely used fiber in the united states and first in the rest of the world. cotton is very good quality, the appearance of its name on a garment label indicates that a better quality cotton fiber was used to make the fabric (Joseph, 2002). Cotton is a soft fiber, staple fiber that grows in a form known as a seed of the cotton plant a shrub native to tropical and subtropical regions around the world, including the America, India and Africa. The fiber most often spun into yarn or thread and used to make a soft widely used nature- fiber cloth in clothing today (Rastoyi, 2004). Among the seed and fruit fibers, cotton has grown in status as the most important textile fiber in the world. In fact, cotton is the textile trade, backbone, and foundation of the world, textile trade and industry.

Medicinal herbs are the local heritage with global importance. The world is endowed with a rich wealth of meditation herbs. The variety and sheer number of plants with therapeutic properties due to the presence of various complex chemical substances of different composition, which are found as secondly plant metabolites, according to their composition, are grouped as alkaloids, glycosides, corticosteroids, essential oils etc. During the past decade, a dramatic increase in exports of medicinal herbs attests to worldwide interest in these products as well as in traditional health systems. The pharmaceutical industries have made massive investment on pharmacological, clinical and chemical researches. Efforts have been made to discover drugs that are still more potent. The benefits of these efforts would reach to the masses in future in farmers initiates commercial cultivation of medicinal herbs (Panda, 2004).

Annona squamosa. L commonly known as Tamil sitapalam, English sweets and custard apple, is a native of West Indies and is cultivated throughout India, mainly for its edible fruit. The young leaves of *A.sqaumosa* are used extensively for their anti diabetic activity. The plant contains atropine alkaloids, carbon, and linalool, limonene (Likcy, 2005). The green fruits, seeds and leaves have effective vermicidal and insecticidal properties. In addition, the pytochemical isolated from *A.sqaumosa* have shown the Antimalarial, Antidiabetic, hepatoprotective, Antitumor, Antimicrobial, anti HIV-1 and wound healing activities (Rajsekhar, 2011). *Annona squamosa* Linn is a small evergreen tree is cultivated throughout India for its fruits different parts of *Annona squamosa* line are used in folkloric medicine for the treatment of various diseases (Kavita, 2006). The hot water extract of *A.sqaumosa leaves* has been reported to posses' hypoglycemic and antidiabetic activity (Watal, 2005). Antimicrobial and insecticidal properties of partially purified Flavonoids from an aqueous extract of *A.squmosa* have been reported against callosobruchus chinensis (Maheswari,2002).

Various medicinal plants have been used for years in daily life to treat diseases all over the world. Interest in medicinal plants reflects the recognition of the validity of many traditional claims regarding the value of natural products in healthcare (Nair *et al*., 2005). In the present day world most of all very conscious about our hygiene and cleanliness. Clothing and textile are a very suitable medium for the growth of the microorganisms. They can act as the carriers of some microorganisms such as pathogenic bacteria, odor generating bacteria and mold fungi. Microbial infestation poses danger to both living matters. Therefore, in the textile and garment world, finishing plays a vital role for quality and value (Srivastava *et al.*, 2011).

Finishing is the treatment of fabrics that produces finished textile goods. Finishing is one necessary aspect that gains good appearance and feel of the garment. Functional finishes are non-toxic and free in nature. The antimicrobial finish controls the growth of odor causing bacteria arising in the human body use of apparel and home textiles. Antimicrobial treatment is necessary for textile materials, in order to control microorganisms, to reduce odor from perspiration, to reduce the risk of cross infection being carried by the feet, to control the spread of diseases and determination of textile fabrics (Dinesh *et. al*, 2011). The need for antimicrobial textile is increasing nowadays, due to determine the effects of microorganisms on textiles as well human hygiene. So it's essential to control or inhibit the growth of these organisms on textile fabrics which turns out to be undesirable for the wearer as well as the textiles itself.

The natural and eco-friendly antimicrobial agents for textile applications are gaining in interest in recent times (Jayakumar, 2011). Antibacterial activity of small ones, like, silver, zinc, copper, and quaternary ammonium compounds are well documented. The silver impregnated textiles are used as wounds at high risk of infection, whereas linkages between biocide moieties and cellulose, are covalently formed on reactive sites (Aberti, 2003). Antimicrobial finishes help to protect fabrics against mold, mildew and bacteria attacks. In addition to the finishes described here, several manufactured fibers are produced with antimicrobial agents incorporated into the fiber structure. These modified acetates, acrylics and olefins can provide durable protection against growth of microbes (Tortora, 2001).

Considering above facts the investigator selected the research work on the topic, "**Comparative study on Antimicrobial Property of *Annona squamosa L.* Leaves and seeds**" with the following objectives.

- To select herbs for antimicrobial finishes
- To optimize the parameters required for the finish
- To select the finishing technique
- To study the standard testing method for antimicrobial activity
- To produce the end product from the finished fabric

2.REVIEW OF LITERATURE

The review of literature pertaining to the study entitled **"Comparative study on Antimicrobial Property of *Annona squamosa L.* Leaves and seeds"** is discussed under the following aspects:

2.1. Cotton

2.1.1. History of Cotton

2.1.2. Importance of Cotton

2.1.3. Properties of Cotton

2.1.4. Uses of cotton

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2.4.5. Mechanism of Antimicrobial activity

2.1 Cotton

2.1.1 History of Cotton

No one seems to know exactly when people first began to use cotton, but there is evidence that it was cultivated in India and Pakistan and Mexico and Peru 5000 years ago. In these two widely separated parts of the world, cotton must have grown wild. Then people learned to cotton were grown. In Mediterranean countries and shipped from there to mills in the Netherlands in Western Europe for spinning and weaving (Kaplan *et al*., 2002). Among the seed and fruit fibers, cotton has grown in stature as the important textile fiber in the world. In fact, cotton is the backbone and foundation of the world's textile trade and industry. (Ghosh *et al*. 2004). It has many unique qualities and countless end uses, which make it still one of the most abundantly, used textile fibers in the world (Sivaramakrishnan *et al*., 2013).

2.1.2 Importance of cotton

It is grown in more than 100 countries in the world. Cotton is most usage fiber in the world. At the farm level alone, the production of each gear's crop involves the purchase of more than $5.3billion worth of supplies and services (Thomas, 2006). Mostly the countries in the region, cotton is vital or, indeed the largest source of foreign exchange, with little or no possibilities of diversification in the short to medium term (The economic study, 2006). Cotton is one of the most important and widely produced agricultural and industrial crops in the world. Cotton plays an important in industrial development starting in the seventeenth century and continues to play an important role today in the developing countries (Townsend, 2005).

2.1.3 Properties of cotton

The quality of cotton, as determined on the basis of its color, length, strength, fineness and most of all the degree of contamination significantly affects its price, cotton being a natural product, varies widely in its fiber characteristics also determine conservation costs and products end-use, price and quantity (sivaramakrishnan, 2013). Cotton is the most important of all natural fibers, according for half of all the fibers used by the world's textile industry. The ability of water to penetrate right to the core of the fiber makes it easy to remove dirt from the cotton garments, and creases are easily removed by ironing cotton fabric is soft because good moisture absorption qualities. Charges of static electricity do not build up readily on the clothes. Length, width ratio, tenacity (strength) flexibility, acceptable extensibility for processing, cohesion, uniformity physical shape, specific quality, moisture regain and moisture absorption, elastic character, thermo plasticity, resistance to solvent, flammability, luster (Kaplan *et. al*, 2002). It has a 10% increase in strength when wet and is shaped like a flat twisted tube when viewed under a microscope (Joseph, 2004). The functional properties of cotton in respective tensile strength, uniformity, and fitness, appearance, wear -life, wrinkle resistance, dimensional stability, elasticity feel and weaving comfort etc. (Jefferson, 2005).

2.1.4 Uses of cotton

Cotton is used to make a number of textile products. This includes apparel terrycloth, used to make absorbent bath towels and robs, socks, underwear and most T-shirts are made from cotton. Bed sheets often are made from cotton (Sonali, 2009). Every part of the cotton plant is useful, the fiber most important part of the plant because it is used in making cotton cloth. Cotton is extensively used in apparel fabrics for men and women warriors and household fabrics like bed sheets, towels, rugs and carpets. Cotton is blended with other man- made fibers like polyester, viscose, acrylic etc. To be used for a variety of purposes. It can also be used in industrial applications as tire cords, bags, shoes, and medical supplies and equipments (Jindal, 2007) From all types of apparel, including as truncates in-flight space suits, to sheets and towels, tarpaulins, tents, cotton is today's fast moving fiber world is still nature's wonder fiber. It provides thousands of useful products and supports millions of jobs as it moves from field to fabric (Gupta, 2007).

2.1.5 Advantages of cotton

The fiber has good strength and abrasion resistance. It is hydrophobic (e-1/2 moisture regained), absorbs moisture quickly and dries quickly. Quick drying a cooling effect. Cotton has less luster and has poor elasticity and resiliency. It is greatly weakened by resin chemicals used in finishing and by acid, but is highly resistant to alkalis (Joseph, 2004).

2.1.6 Applications of Cotton

The major end uses for cotton fiber include apparel, home furnishings and other industrial uses. Cotton has many versatile intrinsic qualities that make it a fiber for all masses of occasions (Rajeshkanna, 2005).

2.2 Medicinal plant

Medicinal plants have been used from ancient time for their medicinal values as well as to impart flavor to the food. Nowadays, the crude extracts and dry powder samples from medicinal and aromatic plants and their species have been showing interest in the development and preparation of alternative traditional medicine and food additives (Karadogan, 2004).

2.2.1 *Annona squamosa*

Alkaloids present in *A. squamosa* leaves have provided to have been evaluated hepatoprodective activity against diethylynitrosamine induced liver injury in mice (pannerselvam, 2009). Flavonoids isolated from aqueous extracts of *Annona squamosa* Linn have been shown antimicrobial activity. The Ethnologic extract of the leaves and stem is reported to have anticancer activity (Panneerselvam, 2009). The ripe fruits of this plant are applied to malignant tumors to hasten suppuration. The seeds are a crud and poisonous powdered seeds serve as fish poison and insecticides. A paste of seed powder has been applied to the head to kill lice. It is also used for destroying worm in the wound of cattle’s (Ekramul, 2003).

2.2.2 Properties of *Annona squamosa*

The crude plant extracts are advantageous in terms of efficacy and pest resistance management as the active substances present in them act synergistically. At the height of differences between Geo-climatic zones and biodiversity, the plant kingdom remains an untapped vest reservoir of new molecules endowed with massive biopesticidal. Over the years, more than 25000 belonging to 235 families have been shown to posses' biological activity against various categories of pests (Mann, 2000).

2.2.3. Uses of *Annona squamosa*

Annona squamosa is traditionally used for the treatment of worm infestation, constipation, hemorrhage, dysuria, fever, thirst, ulcers and as an abortifacient . Alkaloids present in *Annona squamosa* leaves have provided to have been evaluated hepatoprotective activity against diethylynitrosamine induced liver injury in mice (Panneerselvam, 2009). Natural antioxidants can product the human body from free radicals that may cause some chronic diseases, including cancer, cardiovascular diseases and cataract. Flavonoids isolated from aqueous of *Annona squamosa* limn has been shown antimicrobial activity. Bullatacin is one such compound that possessed antimicrobial and pesticide activity in vitro. The ethanolic extract of the leaves and stem is reported to have anticancer activity (Ekramul, 2003).

2.3 Finishing

The word "finish" means all the different treatment applied to a fabric to change one or more of the following:

- Appearance
- Feel or hand
- Wearability or care requirements

Textile finishes are classified in several ways, according to function, these can be classified into:

1. Aesthetic finishes, which modify the appearance and/or hand or drape of the fabrics.
2. Functional finishes, which improve the performance properties of the fabric such as durability, strength etc.. 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 (ex) Aesthetic finishes
    - Calendaring
    - Mercerization
    - Napping and seeding
    - Shearing (Anand, 2000).

Finishing is not only what catches the eye, but the feel and touch that the treated materials impacts. Buyers always expect a high degree of wearing comfort and finishing plays, an important role in achieving (Sivakumar *et.al*, 2008). The dyed and printed fabric is applied with different finishing chemicals to impart comfort feel, as well as desired functional effects like wrinkle free, easy care, water-oil- stain repellency, moisture management flame retardency, UV production, antimicrobial insect repellent sensory perception odor absorbent properties of various thermo chemical application methods like, padding, coating, spraying (Ashok, 2013). After bleaching, dyeing and printing the textile material is expected to acquire aesthetic value, serviceability and comfort, so that is can attract the buyers. The textile finishing aims at the improvement in appearance, handle, dimensional stability and serviceability render the textile material fit for their end users (Patil *et al*., 2011).

2.3.1 Types of finishing

The term finishing means completing the manufacture of cloth by surface treatment. It abroad sense, it covers all the treatments it undergoes after leaving the loom or the knitting machine till it enters the market and includes processes like bleaching mercerizing, dyeing and printing. Types of textile finishes can be divided into functional finishes and aesthetic finishes. Functional finishes are used to alter fiber or fabric performance, maintenance, durability, safety, and environmental resistance. Finishes that are applied specifically to alter properties related to care, comfort, and durability are generally considered functional finishes. Most functional fabric properties are imported using chemical, wet processing methods (Hyde, 2007).

2.3.2 Functional Finishes

Functional finishes affect a fabric's performance more than is appearance or hand. These finishes include water repellents, flame-retardants, antistatic, bacteriostats, and mothproofing. This finishes also affect the care of the fabrics and include soil and stain resistant’s or minimum-care finishes (Condra, 2003).

2.3.3 Classification of finishing

In the technological literature, finishes (and finishing treatments) are divided into groups. Mechanical and chemical finishes. Mechanical finishes can be achieved without the addition of compounds, for example calendaring involving heat, moisture and pressure. Chemical finishing involves the application of compounds as finishing agents, which may not include chemical reactions (Eastop, 2012). Permanent finish, durable finish, semi durable finish, temporary finish on the basis of degree of performance, generally It is classified as basic finishes and special or functional finishes (Mullik, 2006).

2.4 Antimicrobial finish

Antimicrobial finishes, particularly important for industrial fabrics that are exposed to cold weather conditions. Fabrics used for wings, windscreens, tents, tarpaulins, ropes, frost protection from rotting and mildew. Home furnishing textiles such as carpets, shower curtains, bath mats, floor mats, mattress ticking, and upholstery also require antimicrobial finishes. Fabrics and clothing used in places where there might be danger of infection from pathogens can benefit from antimicrobial finishing (Kumar, 2013).

2.4.1 History of Antimicrobial

The history of Antimicrobial begins with the observations of pesticide Joubert, who discovered that one type of bacterial could prevent the growth of another. They did not know at that reason one bacterium failed to grow was that the other bacterium was producing an antibiotic. However, the further effect of antimicrobial therapy is somewhat in doubt. Microorganisms, especially bacteria, are becoming resistant more quickly than new drugs. However, the microorganism is becoming resistant more quickly than new drugs, are being made available; thus future research in antimicrobial therapy may focus on finding how to ever come resistance to antimicrobials or how to treat infections with alternative means, such as pieces (Ramakrishna *et al*., 2007).

2.4.2 Benefits of antimicrobial

The user of the textile products can therefore expect them to be safe in use and not to pose a health risk. If, for instance, an employer demands that specific work wear is worn or actually provides such work wear, he must ensure that this is safe as part of his duty of care towards his employee (Isner, 2006). A wide range of textile product is now available for the benefit of the consumer. Initially, the primary objective of the finish was to product textiles and technical textiles such as Geo-textiles have therefore all been finished using antimicrobial agents. Later, the home textiles such as curtain coverings, and bath mats came with antimicrobial finish. The application of the finish is now extended to textiles used for outdoor, healthcare sector, sports and leisure (Maheshwari, 2010).

2.4.3 Application of antimicrobial activity

The rountinery used textile material or which is coming in contact with the body is more prone to attack by microorganism. This is because during perspiration or when in contact with the body, the organisms present on the body gets transferred on to cloth resistant to attack by microorganisms, then it can lead to determination and hence change in the physical properties of the textile material (Kumar *et al.,* 2013).

2.4.4 Properties of antimicrobial activity

The antimicrobial properties of such textile material can be grouped into two categories, temporary are easy to achieve in finishing, but easy to lose in laundering. Durability has generally been accomplished by a common antibacterial agents are incorporated into fibers or fabrics by means of a wet finishing process (Se-kwin Kim, 2003).

2.4.5 Mechanism of antimicrobial activity

Despite the long list of requirements, a variety of chemical finishes have been used to produce textiles with demonstrable antimicrobial properties. These products can be divided into two types based on the mode of attack on microbes. One type consists of chemicals that can be considered to operate by a controlled release mechanism. The antimicrobial is slowly released from a reservoir either on the fabric surface or in the interior of the fiber (Peter, 2004).

2.4.6 Significance of Antimicrobial Activity

1. Gives freshness to the fabrics
2. Eliminates odor produced by microorganisms
3. Controls staining due to microbial growth
4. Improves the durability of the fabric by controlling growth of microbes
5. Prevents skin diseases
6. These finishes increase the comfort and hygiene factor making the clothing more pleasant to wear older can be neutralized and skin problems caused by microbial growth can be reduced, thus emphasizing the hygienic nature of the treated product (Saravanan, 2005).

2.4.7 Techniques for applying antimicrobial finish

1. Exhaust and pad-dry-cure processes can be used for antimicrobial finishing on natural as well as synthetic fibers for the application of biocides such as triclosan etc.
2. Padding, spraying and foam finishing have been for the silicon- based quaternary agents

3. An emerging method for antimicrobial finishing is to use the sol-gel process which allows the fabrication of materials with a large variety of properties-ultra fine powders, monolithic ceramic fibers, inorganic membranes thin film (Cransto, 2008).
4. Microencapsulation of a chemical agent with the fiber in a matrix (Choudhury, 2008).

2.5. Fungal introduction

Antifungal textiles have been mainly developed for the production of textile itself and a better preservation of the characteristics' of the fiber. Dampness favors the development of microscopic fungi, which can damage the textile and cause permanent coloring (Singh, 2006). Fungi are thallophytic that have no green plant pigment. Spores generally reproduce fungi. The fungi derive organic substances from the bodies of other organisms, living or dead. The fungal body, which is generally called thallus, is either a single cell or a thread structure. That is called hyphae. In the most fungi, spore-producing cells, from a part of special structure made up of hyphal tissue and called the fruit body. The simplest part of fungi possess a unicellular, filamentous, branching thallus, whose cytoplasm contains, a great member of partitions to divide them. (Mishra, 2005).

2.6. Bacteria introduction

E. coli can carry genes that allow the bacteria to colonize the small intestine, where bacterial numbers are usually very low. This allows the bacteria to have earlier access to the nutrients passing down the gastrointestinal tract, removing the need to complete with the bacteria of the large intestine (Amyes, 2013). Bacteria produce many enzymes that digest or change complex food materials into simpler compounds into larger compounds. Certain bacteria are able to synthesize all compounds necessary for growth from sugars and essential elements. Other must obtain certain growth factors, vitamins, and/or amino acids from the environment. Bacteria occur everywhere- in soil, water, air, food, dust, the oceans-and are found on and in plants and animals.

2.7. Microbes used in textiles

Microorganisms have affected the textile industry through the development of more efficient and more environmentally friendly manufacturing processes, as well as through the design of improved textile material. Some of their key roles have involved the implementation, production of novel and biodegradable fibers from biomass feedstock's (Soni, 2007). Textiles incorporating antimicrobial agents might not prevent the penetration of or direct contact with viable ring use pathogenic microbes during use, as the effectiveness of antimicrobial agents requires direct contact with the microbes for a specific period under defined conditions (Maheswari, 2010). Textiles designed for biological protection have two functions: first protecting the wearer from being attacked by bacteria, yeast, dermatophytic fungi, and other related microorganisms which cause aesthetic, hygiene, or medical problems: secondly, production the textile itself from deterioration caused by mold, mildew, and rot- producing fungi and from being digested by insect and other pests (Craighead, 2011).

2.8. Product Development

Medical textiles account for a huge market due to widespread need not only in hospitals, hygiene and healthcare sectors but also in hotels and other environments where hygiene is required. There has been a sharp increase in the use of natural as well as synthetic fibers in producing various medical products (Francis, 2011). Skin contact properties are not only of interest in clothing but also for bed linen and medical coverings used at the patient-device interface (Bartly, 2011). However, even though textiles have been suspected as media for transmitting pathogens, textile products were not clinically proven as a source of directly causing infections (Garcia, 2013). The aim of antimicrobial textiles is to offer better hygiene by limiting the proliferation of bacteria. The textiles cannot in any way claim a medical action, such as prevention of skin diseases (Ayaraman, 2012) (plate xx)

3.EXPERIMENTAL PROCEDURE

The methodology of pertaining to the study entitled **"Comparative study on Antimicrobial Property of *Annona squamosa L.* leaves and seeds"** is discussed under the following side heading

3.1 Selection of Fabric

3.2 Preparatory process

3.2.1 Desizing

3.2.2 Scouring

3.2.3 Bleaching

3.3 Collection of Source

3.3.1 Preparation of *Annona squamosa* seed and Leaf extraction

3.3.2 Extraction of Active Compounds from *Annona squamosa* seed and Leaf

3.3 Determination of Suitable Solvent for Extraction

3.4 Selection of Finishing

3.5 Optimization of Finishing Process

3.6 Application Method

3.6.1 Padding mangle

3.7 Evaluation of Finished Fabrics

3.7.1 Physical Property

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3.7.1. b. Fabric Weigh

3.8 Mechanical Property

3.8.a. Fabric Tensile Strength and Elongation

3.8.b. Abrasion Resistance

3.8.c. Pilling Test

3.9 Comfort Property

3.9. a. Fabric Stiffness

3.9.b. Drape Test

3.10 Absorbency Property

3.10. a. Drop Test

3.10. b. Sinking Test

3.10. c. Wicking Test

3.11 Antimicrobial test (qualitative test)

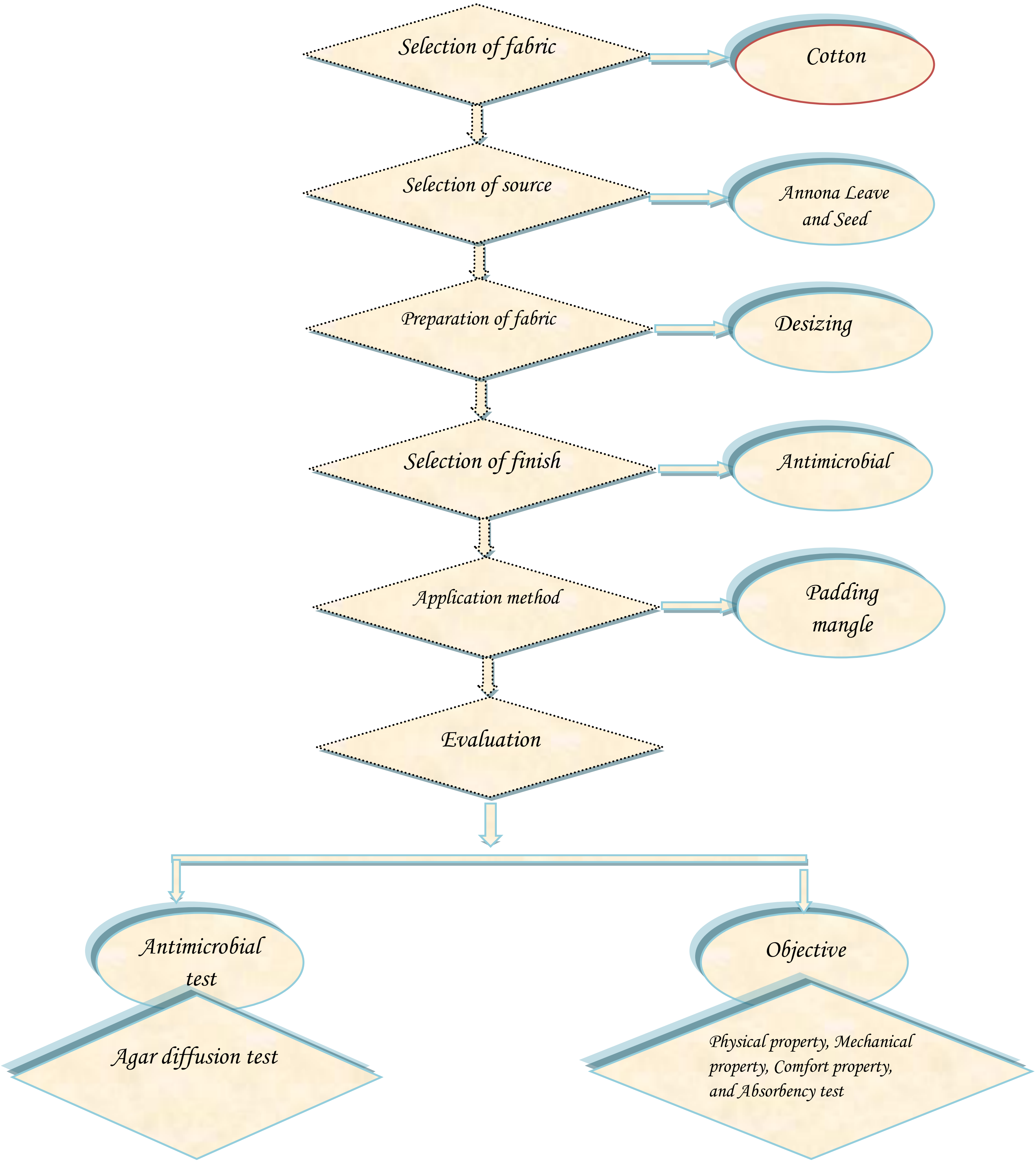
3.11.a Agar-well diffusion method (Bacteria)

3.11.b Agar-well diffusion method (Fungi)

3.12 Statistical Analysis

3.13 Nomenclature

FLOW CHART


Selection of fabric
Cotton
Selection of source
Annona Leave and Seed
Preparation of fabric
Desizing
Selection of finish
Antimicrobial
Application method
Padding mangle
Evaluation
Antimicrobial test
Agar diffusion test
Objective
Physical property, Mechanical property, Comfort property, and Absorbency test

3.1 Selection of material

It is wonderfully versatile and globally important fiber due to its exellent properties like absorbency, biodegradable, breathable, drape, easily sterilized, high weight strength, insulation properties, non-allergenic, renewable resource, softness and water retaining capacity. Cotton continues to dominate the natural fibers and can be formed in to woven, braided, non-woven or knitted fabric types (Cothern, 2005). Cotton fabrics are characterized by good wearing qualities, excellent luanderabillity, high absorbency, good color fastness, easy dye ability and good pliability (Mishra *et.al*, 2009) Cotton fabric have a pleasant material, luster, a soft drape and a smooth hand they are very comfortable to wear due to their soft hand and other characteristics cotton fabrics have excellent absorbing capabilities. Cotton can stand high temperatures and takes dyes easily. Fabrics that are 100% cotton do shrink if they have not been treated with a durable- press or a shrinkage resistant finish (Mahapatra, 2013). It is not affected by friction and is a good conductor of heat. It is highly resistant to sunlight, heat and alkalis but is deteriorated by the action of acids and oxidizing agents such as hydrogen peroxide and chlorine bleaching compounds (Hall, 2002). 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 tire cords, bags, shoes and medical supplies and equipments (Jindal, 2007).

Annona leaves and leaves powder

PLATE I

Annona seed and powder

PLATE II

3.2 Preparatory process

The aim of the pretreatment operations for cotton is to remove the natural and added impurities to the maximum possible extent with minimum loss in strength of the fabric (chaven, 2013)

3.3 Desizing

Desizing is the process in which the size applied to the warp yarn before weaving is removed to facilitate the penetration of dyes and chemicals in the subsequent wet processing operations. About 65% of the cotton used for textiles is made in to woven fabric. Desizing process is three methods:

1. Rot steeping
2. Acid desizing
3. Enzymatic desizing (karmakar, 2011).

Although it is the most important operation but in many mills it is neglected. The main ingredients of size mixture are starch, wax and tallow; they remain on the warp yarn after weaving. An emulsifying agent is also added to sizing mixture, which facilitates the subsequent removal of size ingredients (Kara, 2011). Desizing of cotton fabric is the most important step necessary to make fabric suitable for further processes including scouring, bleaching ect. Desizing is most commonly two categories:

1. Oxidative
2. Acid desizing (Khanan, 2013)

The selected fabric was desized in water bath containing water along with chemicals and temperature was maintained 60^{o}C for 80 minutes. Then the fabric was taken out, rinsed thoroughly and dried in shade (plate iii)

Table I

RECIPE FOR DESIZING

S. NO	PARTICULARS	PARAMETERS	SELECTED PARAMETERS
1.	Fabric Weight	262.94grams	262.94grams
2.	Hydrochloric acid	Few Drops	Few Drops
3.	Water	Fabric weight X liquor radio	7.9 liters
4.	Temperature	60° C	60° C
5.	Time	80 minutes	80 minutes

3.4 Scouring

Scouring is the process by which oils, fats, wax and other nitrogenous, matters and removed. Process is carried out by adding 2g/1 caustic soda, 1g/1 soda ash and 1g/1 T.R.O as and then the temperature is raised to boiled and process continued for 3-4 hours under the pH $10^{-11.5}$ (Vanker, 2010) . Process for removing natural and acquired impurities from fibers and acquired impurities from fibers and fabric (eg.wax, pectin's). It also supports subsequent bleaching and dyeing processes scour baths usually contain alkalis, antistatic agent, lubricants, detergents, emulsifiers (smith, 2006).

The selected fabric was scoured in water bath containing water along with chemicals and temperature was maintained at 60^{o}C for 1 hour. Then the fabric was taken out, rinsed thoroughly and dried in shade (plate iii)

Table II

RECIPE FOR SCOURING

S. NO	PARTICULARS	PARAMETERS	SELECTED PARAMETERS
1.	Fabric Weight	262.90 grams	262.90 grams
2.	Sodium hydroxide	3%	7.887 grams
3.	Sodium carbonate	2%	5.258 grams
4.	Wetting agent	Few drops	Few drops
5.	Water	Fabric Wight X liquor ratio	8.787 liters
6.	Temperature	100° C	100° C
7.	Time	80 minutes	80 minutes

3.5 Bleaching

Bleaching process elestroys colored impurities, process condition should permit only rendering color impurities colorless and there should not be any tendering of cotton fibers. Natural hydrogen peroxide is not an effective bleaching agents (Prabu *et.al,* 2010). Wet bleaching with chlorine may be effected by two different methods; either by the use of a chloride of lime solution. The bleaching liquor from chloride of lime is prepared by stirring a weighted quantity of chloride of lime with lead or provide with a thick coat of white- lead paint. Crushing the lamps formed and finally adding, while stirring constantly the necessary quantity of water (Brannt *et.al,* 2008).

The selected material was bleached in a bath containing 7.887gm of sodium hydroxide, g5.258m of sodium carbonate, and few drops of wetting agent in an 8.787liters of water MLR 1:30 at 100^{o}c for 80 min. After bleaching, the material was taken out, rinsed thoroughly, and dried (plate iii).

PLATE III

DESIZING, SCOURING, AND BLEACHING

OF COTTON FABRIC

Table III

RECIPE FOR BLEACHING

S. NO	PARTICULARS	PARAMETERS	SELECTED PARAMETERS
1.	Fabric Weight	262.90grams	262.90 grams
2.	Sodium silicate	3%	7.887 grams
3.	Hydrogen peroxide	2%	5.258 grams
4.	Wetting agent	Few drops	Few drops
5.	Water	Fabric weight X liquor ratio	8.787 liters
6.	Temperature	100°C	100° C
7.	Time	80 minutes	80 minutes

3.3 Collection of source

3.3.1 Preparation of *Annona squamosa* seed and Leaf

The fresh leaves and seeds of the plant *Annona Squamosa* samples collected from the local area of Coimbatore, Tamilnadu. The collected leaves and seeds were washed with running tap water and allowed to air dry. The plant materials were dried in shade for two or four weeks. Precaution was taken to avoid direct sun light otherwise; it will destroy the active compounds of plant leaves and seeds. After the plant leaves were grained finely and stored airtight cover. The green fruits, seeds and leaves have effective vermicides and insecticidal properties. In addition, the photochemical isolated from *Annona Squamosa* have shown the Antimalarial, antimicrobial properties and cytotoxic activity against the tumors (Rajsekhar, 2011) (plate i,ii)

3.3.2 Extraction of Active Compounds from *Annona squamosa* seed and Leaf

Soxhlet extraction method

The leafs and seeds cotyledon materials were grounding a grinding machine in the laboratory then 30g of shade-dried powder was weighed and extracted successively with ethanol in soxhlet extractor for 48h. The ethanol extracts were concentrated under reduced pressure and preserved in refrigerator in airtight bottle for further use. The dried powder samples of extracted with ethanol (300 ml) using Soxhlet extractor for 48 hours until complete extraction. After extraction, it was filtered and evaporated by rotary evaporator to give amophorous solid masses. The crude extract (6.12 g).The crude extracts was transferred into a separator funnel and finally extracted by different solvents.

3.3.3 Determination of Suitable Solvent for Extraction

The active compounds from the *Annona Squamosa* seed and leaf was extracted using various solvents such as ethanol, methanol, acetone, and chloroform. For extraction, 10gms of the powder of *Annona Squamosa* seed and leaf was taken in a conical flask and mixed with 100ml of ethanol. Then the flask was kept in soxhlet extractor at100ºC for one day. Next day the solution was filtered using filter paper stored at 4ºC. The same procedure was followed for extraction of active compounds from *Annona Squamosa* seed and leaf using methanol, chloroform and acetone. After extraction, the solution was evaluation for antimicrobial activity by agar diffusion method. Then the solved, which shows the maximum zone of inhibition, was selected for further finishing process. The activity showed the best result in the ethanol medium. Therefore, I selected ethanol as medium.

PLATE IV

Seed extraction

Leafs extraction

3.4 Selection of finishing

Antimicrobial finishes have increased its importance in the recent years for several reasons. They serve the consumer by offering protection from the harmful effects of certain microbes. More commonly, the finish in designed to inhibit odour that may have been generated by the body, soils, contaminates, the finish is designed to it inhibit odour that may have been generated by the body soils, contaminants, or personal care products (sivaramakrishnan, 2007). Antimicrobial are used on textiles to control bacteria, fungi, mould, mildew, yeast and the problems of fabric rotting, staining, un pleasant odour and health concerns ranging from simple discomfort to physical, irritation, allergic sensitization, toxic responses, infection and disease that the presence of microbes can raise. Hence, these finishes minimize or control the action of microbes preventing the transfer and spread of disease promotes and protects the delicate human skin (Goyal *et.al*, 2007). Medical application of encapsulation has centered on the delivery of drug treatment through clothing, to patients. One such application involves the delivery of antimicrobial treatments to cut down the bugs causing the hospital super infection MRSA. The potential of microencapsulation for use in sportswear, underwear, and work wear is soon recognized and now it is becoming a common treatment for fashion clothing (Saloni, 2013). The consumers are now increasingly aware of the hygienic life style and there is a necessity and expectation for a wide range of textile products finished with antimicrobial properties. Botanical research shows that some plant species exhibit extraordinary antimicrobial properties (Srivastava, 2010). Hence, Antimicrobial Finishing was selected for this present study.

3.5 Optimization of antimicrobial finish

The optimization of standard condition for antimicrobial finish was done for original and treated fabrics. Optimization for antimicrobial treatment was carried out for various parameters such as extract concentration time and temperature after giving the finish to the fabric. The sample where taken out, dried and the antimicrobial activity was evaluate

PLATE V

ANNONA SQUAMOSA SEED SOLUTION

ANNONA SQUAMOSA LEAVES SOLUTION

3.5.1 Concentration of herbal solution

The fabric was treated with three different concentrations of *Annona Squamosa* extract of seed and leaf. The material liquor ratio was 1:15. The concentrations were varied from 0.5g, 1.0g and 1.5g with constant temperature of 40ºC respectively. After 1 hr, the samples were taken out, dried and its antimicrobial activity was evaluated. The concentration level of 0.5 and 1g did result to the activity but only in 1.5g level of concentration the activity was enriched enough so that it could be used for the study.

3.5.2 Determination of optimum time for finish on fabric

The antimicrobial finish of cotton fabric treated with extract of *Annona Squamosa* seed and leaf was carried out at optimized concentration with constant temperature of 40ºC for different time intervals like 1hr, 3hrs and 5hrs. After treatment at different time interval, the fabric is taken out and evaluated for antimicrobial activity. The time, which shows the maximum zone of incubation, was selected for further finishing process.

Table IV

Optimization parameters

Parameters	Levels
Concentration	0.5g, 1.0g and 1.5g of extract
Time	1hr, 3hrs and 5hrs
Temperature	40ºC, 50ºC and 60ºC

3.6 Application method

3.6.1 Padding mangle

The wet finishing treatment to increase the barrier effect of the fabric was carried out under the application of finishing agents by means of well-known padding method (Rajendran, 2005). This technique is related to coating and, as has already been mentioned is actually a method of producing a coated fabric, if carried out repeatedly. Fabric “padding” or “dipping” terms for impregnation is universally used in fabric finishing (Choudhury, 2006). In order to obtain consistent chemical application; the nip pressure should be uniform across the fabric width. The solution level and temperature in the pad should be constant and the fabric speed should not vary throughout the application process (Hauser *et al*., 2004)

The finishing solution was prepared by mixing the solvent extract (500 ml/l) with liquor ratio 1:80. The cotton fabric was placed in the finishing solution and kept there for 20 min. then the fabric was taken out and padded in the padding mangle with 80% wet pick up to get an even distribution of finishing and was then air dried at room temperature. The wet pick up or percent expression is calculated as follows:

$$\text{Percentage expression} = \frac{W_1 - W_0}{W_0} \times 100$$

Where W_1= weight of the fabric after padding, and W_0= weight of the fabric before padding (Kim, 2011).

PLATE VI

PADDING MANGLE

3.7 Evaluation of Finished Fabrics

To evaluate the impact of the finish given on the Antimicrobial treated fabric samples and untreated fabrics samples. The samples were evaluated objectively.

3.7.1 Physical Property

Physical properties include those that characterize the physical structure of the fabric and test that measure these properties are sometimes called characterization tests. Physical properties include fabric thickness, width, weight and the number of fabric weight, fabric thickness, and fabric count.

3.7.1.a. Fabric Thickness Testing (ASTM 1777)

Fabric thickness is an important property that adds to the insulating effect. Two thin layers of fabric are more effect. Two thin layers of fabric are more effective than one thick layer because there is extra dead air space between the two layers. Fine fibers fill up spaces in fabric layers and increase its insulating effect. Thickness gauge is the instrument used for measuring fabric thickness (Arrora, 2010). In order to determine the thickness of a compressible material such as textile fabric, the precise measurement of the distance between two parallel plates should be measured with the cloth separates them. A known arbitrary pressure between the plats should be applied and maintained. It is useful to measure fabric thickness is also useful to measure fabric thickness in order to check the material against the specification. Fabric thickness is also useful in studying fabric properties such as thermal insulation, resilience, dimensional stability, fabric stiffness, abrasion and total handle value (Kothari, 2012).

The Hungarian thickness tester was used. It has two parts, the anvil and the presser foot, which works under a lever spring action. On the top, a dial indicated the thickness of the sample in the thousand of an inch. Each division on the dial read is 0.01 mm. The sample was placed on the anvil plate, the lever of the presser foot released very slowly, and the presser foot pressed the sample. The dial indicated the thickness of the sample. Ten readings were taken from different places of the fabric samples and the mean was calculated (plate vii).

3.7.1.b. Fabric Weight (ASTM 3776)

Fabric weight is determined by weighting the complete piece roll, cut, or bolt, or by selecting and weighting the a full with sample, ¼ yard in length there from the weight per square yard, weight per square yard, weight per linear yard, per pound maybe calculated as follows yards.

$$\text{Fabric weight} = \frac{\text{fabric weight in Ibx6x36}}{\text{Fabric length in yards}} \text{ X width in inches}$$

The O was cut with GSM (Grams per Square Meter) die cutter which is 100 cm^2. The sample was weighed in an electronic balance. The weight of the sample was measured in grams and multiplied with 100 to get GSM value. Five samples were tested and the average was calculated. The same procedure was followed for all OC, PC, LTC, STC samples (plate viii).

Thickness Gauge (plate vii)

GSM Cutter (plate viii)

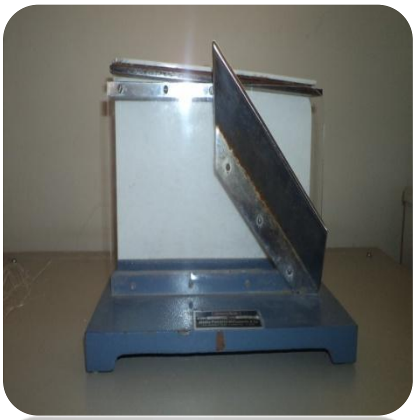
Strength Tester(plate ix)

Abrasion Tester(plate x)

Pilling Tester (plate xi)

DRAPE METER (plate xii)

STIFFNESS TESTER (plate xiii)

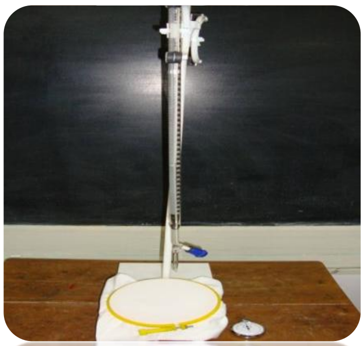


Wicking (plate xiv)

Sinking Test (xv)

)

Drop Test (xvi)



3.8 Mechanical Property

3.8.a. Fabric Tensile Strength and Elongation (ASTM 848)

Tensile strength is the most important property of a fabric. In almost every fabric development and manufacturing, tensile properties are reported. Modules, breaking strength and elongation at break are widely used for quality control. This method of tensile testing was commonly used in textile industries such as cotton, wool and flax, but is increasingly being replaced by the single and strength test method. Another important quality of practical interest is the breaking length of the yarn, expressed in kilometers. The breaking length of the specimen breaking under its own weight when suspended vertically, this quantity is usually calculated from the tensile strength (Hall, 2004.)

Each O sample 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 kilograms and the elongation in inches as well as centimeters was noted as soon as the sample was broken. Five readings were taken and the mean strength and elongation was found out to the strength loss or gain in the fabric before and after finishing. Similarly OC, PC, LTC, STC also tested using same procedure (plate ix).

3.8.b. Abrasion Resistance (AATCC93)

Abrasion tests are clearly most valid. However, despite great effort, their reproducibility and precision is often poor, especially from laboratory to laboratory. The results of these tests will depend on the conditions of the test, and may include the nature of the abrading, and the load or tension applied. Such variables must be reported with the test result (Annis, 2012). A simple class room method to test wear resistance (abrasion) of a fabric is to rub two blocks of wood together one which has been covered with sand paper and the other with strips of different type of fabric (Almer, 2002).The abrasion test has also been used to investigate the adhesion between the sputtered layer and the substrate used the abrasion test to investigate the adhesion between the sputtered layer and textile substrates (Wei, 2009).

Abrasion resistance tester was used to determine abrasion resistance of the sample. Using random sampling five samples were cutted using template. The sample holder with 200 Gms weight was used for this test. The rotations were standardized to 10 min. The samples were made to rub against the abrasive surface. After 10 rotations, the samples were removed and final weight of the sample was found out. Weight loss due to abrasion was calculated. The test was repeated for five samples and one mean weight loss was calculated (plate x)

3.8.c. Pilling Test (ASTM 3512)

Pilling has long been recognized as a fault, especially in fabrics such as woolen knitted, cotton and other goods made from soft twisted yarns, but the introduced of the newer man-made fibers appears to have aggravated its seriousness (Jewel Raul *et.al,* 2005). Also associated with abrasion resistance is pilling, which is the formation of little circular clusters of fiber on the surface of the fabric, produced as a result, of the fabric being rubbed against itself or against some other material (Hardcastle *et.al,* 2001).

Pilling tester consist of two number of cubical wooden boxes constructed in 13mm thick wood with internal sides of 235mm prior to lining. Each box is lined with 3.2mm thick buff-finished cork jointing material. By means of an electric driving unit, each box is rotated at constant 60±2rpm about a horizontal axis passing through the center of two opposite faces. An automatic switch is fitted which will stop the machine after any predetermined number of revolutions.

For testing, remove any fibers or fluff from the empty boxes of test machines by light brushing or vacuum cleaning and inspect the cork linings were or damage. Place 4 mounted specimen in to each box and close the lids. Set the machine to run. After the test time, the machine will stop. Then remove the specimens and assess the pilling standard of the face of each individual specimen. Repeat the above procedure for OC, PC, STC, and LTC samples (xi)

3.9 Comfort Property

3.9.a. Fabric Stiffness (ASTM 1388)

The main purpose of the stiffness function is to provide a means to automate the calculation of the stiffness matrix of arbitrary finite elements and thereby increasing the flexibility of the meshing process. The facility with which the material stiffness matrix can be calculated is not only important in terms of under spinning mesh refinement and adaptive meshing, but more importantly, to conduct a more correct and precise, i.e material adaptive stress analysis (Weissenbach, 2004).

A 5 x 1 rectangular strip of fabric is mounted on a horizontal platform in such a way that it overhangs, like a cantilever and bends downwards. From the length and angle, a number of values are determined. Each specimen is tested four times, at each end and again with the strip turned over. Mean value for the bending length in warp and weft direction can be calculated and if required, values for flexural rigidity and bending modulus can also be included (plate xii)

3.9.b. Drape Test (ASTM 3691)

Drape test systems currently used worldwide include the pierces cantilever method, the fabric research liberating method (FRC drape meter) the cantilever method measures fabric bending characteristics and then converts them in to a measures of fabric drape. In the actual test, the light beam casts a shadow of the draped fabric on to a ring of uniform translucent paper supported on a glass screen. The surface pattern area on the paper ring is directly proportional to the mass of that area. So the drape coefficient can be calculated in a the simple way (Hu, 2008).

$$F = \frac{\text{Mass of shaded area}}{\text{Total mass of paper ring}}$$

Drapebility, coupled with lightness, therefore explains, largely, the success of fibers for clothing and these are often the reasons why fibers find use in technical applications. However, this means that the structure made from fibers is different from other structural material (Bunsell, 2009).

Two small circular plates held a circular piece of fabric, so that its free edges drape down under their own weight. For ordinary textile fabrics, a satisfactory spread of difference in drape behavior is obtained, when the diameter of fabric specimen is 30cm and the diameter of the disc in 18cm.

A value known as drape co-efficient F1 is determined by considering the following,

A_D-the area of the specimen

A_{d-} the area of the supporting disc

A_s-the actual projected area of the specimen

To drape co-efficient is given by

$F=A_s-A_d /A_{D-}A_d$ X100

Thus, the readings were taken from original and all finished samples. Then their mean value was calculated and tabulated (plate xiii).

3.10 Absorbency Property

3.10.a. Drop Test (AATCC 79)

It was noted earlier that in the initial stages of wetting the drops of wetter pearl off the fabrics but in time pearling ceases, the fabric become wet. The drop test is a count of number of drops required to penetrate through to the underside of the fabric when all the drops fall on the same spot (Raul, 2005).

A burette filled with distilled water was clamped in a stand. The 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 kept constant. The nozzle of the burette was opened just to allow a drop of water to fall on the sample. The stopwatch was started simultaneously and it was stopped when the drop of water fully sank into the material. The time taken for this was noted. The same procedure was carried out for the untreated and treated sample and the mean value was calculated and recorded (plate xiv).

3.10.b. Sinking Test (AATCC 79)

Sinking time test can also be carried out on the fabric cutting it in to a specific small size and dropping the same on the surface of water loosely without putting any thrust (choudhry, 2006). Fibers of known density are placed in the column and allowed to reach their stable positions in the liquid i:e. where the density of the fiber matches that of the liquid. The test fiber is introduced into the system and the point at which the sample stops sinking is taken as the point of equivalent density (Houck, 2009).

Five samples were cut into the size of 5 cm x 5 cm square from the untreated and treated samples. A 1000 ml beaker was filled with distilled water. The sample was dropped into the surface of the water from a standard height. The stopwatch was started when the fabric struck the surface of the fabric 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. The mean value was calculated for the above samples. Similarly, the mean values of the untreated and treated samples were calculated and the sinking time of each material was recorded separately (plate xv)

3.10.c. Wicking Test (AATCC197)

Wetting and wicking in textile fabrics are complex processes. The liquid comes into direct contact with, fibers, forming a solid-liquid (wetting) and is then transported in the capillaries between the fibers must first wetted, so wetting is an essential procure or to wicking characteristics of fabrics depend on the chemical nature of both the liquid and the fiber and on the fabric structure itself (Ward man *et.,al*, 2011).This test method measures the distance water will wick up a cut edge of fabric. Sample is conditioned in atmosphere conditions for textiles; 1cm of the sample is submerged in ionized water has moved along a cut edge of fabric is measured (Wasif, 2013).

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 30minuts was taken as a direct indication of the test fabric and recorded in centimeters (plate xvi)

3.11 Antimicrobial test (qualitative test)

The effect of the extracts on the test organisms were studied by following agar diffusion test. Bacteria and fungi were used in this study.

3.11.1 Agar diffusion method (Bacteria)

The *Annona squamosa* leaves and seed treated and untreated fabrics were subjected to antimicrobial assessment using agar diffusion test method. Agar Agar, peptone, beef extract, distilled water were used to prepare the broth in order to grow the culture and it was incubated. The ingredients for the broth preparation are given in the table.

S.NO	Ingredients	Amount of ingredients
1	Distilled water	100ml
2	Agar Agar	1.5
3	Peptone	0.50
4	Beef extract	0.30

Each plate was divided in to two parts in each part the treated sample were placed with the sterile forceps. These plates were then taken and incubated at 40^{o}C for 24 hours. Qualitative assessment was done based on the zone of incubation. The plates were examined for the growth or clear zone of inhibition. The zone was measured using divider and the diameter of each zone of inhibition was recorded.

. 3.11.2 Agar-well diffusion method (Fungi)

The *Annona squamosa* leaves and seed treated and untreated were subjected to antimicrobial assessment using agar diffusion test method. Rose Bengal chlorem phenicol, distilled water were used to prepare the broth in order to grow the culture and it was incubated. The ingredients for the broth preparation are given in the table.

S.NO	Ingredients	Amount of ingredients
1	Distilled water	100ml
2	RoseBengalchlorem phenicol	2.8g

Each plate was divided in to two parts in each part the treated sample were placed with the sterile forceps. These plates were then taken and incubated at room temperature for 48 hours. Qualitative assessment was done based on the zone of incubation. The plates were examined for the growth or clear zone of inhibition. The zone was measured using divider and the diameter of each zone of inhibition was recorded.

3.12 Statistical Analysis

The results of laboratory tests were analyzed statistically using tests for analysis of variance analysis of variance (ANOVA) is an extremely useful technique for analyzing multiple samples. ANOVA is essentially for testing the difference among different group of data for homogeneity (Gupta 1998). ANOVA is commonly used to test differences among the means of several independent groups. Analysis was carried out mainly to see whether the test result vary due to the differences among the means of several independent groups.

3.13 Nomenclatures

The nomenclature of samples is given below:

Table V

S. No	Nomenclature	Abbreviation
1	OC - Original Cotton	OC
2	PC- Pretreated Cotton	PC
3	LTC- Leaves Treated Cotton	LTC
4	STC- Seed Treated Cotton	STC

3. RESULT AND DISCUSSION

4.1 **OBJECTIVE EVALUATION**

4.2 **Physical Property**

4.2.a Fabric Thickness Testing

4.2.b Fabric Weight

4.3.1 **Mechanical Property**

4.3.1.a Fabric Tensile Strength in warp direction

4.3.1.b Fabric Tensile Strength in weft direction

4.3.1.c Elongation of fabric in warp direction

4.3.1.d Elongation of fabric in weft direction

4.3.4.e Abration resistence

4.3.1.f Pilling

4.4 **Comfort property**

4.4.1.a Stiffeness test of warp direction

4.4.1.b stiffeness test of weft direction

4.4.1.c Drape coefficient

4.5 **Absorbency test**

4.5.a wicking test

4.5.b Sincking test

4.5.c Drop test

4. RESULT AND DISCUSSION

The results of the study are discussed **Comparative study on Antimicrobial Property of *Annona squamosa L.* leaves and seeds** under the following headings

4.1 OBJECTIVE EVALUATION

4.2 ASSESSMENT OF PHYSICAL PROPERTIES

The physical properties of the fabric were analyzed for thickness, weight.

4.2.a FABRIC THICKNESS

The results of fabric thickness of the original cotton, pretreated and antimicrobial finished samples are presented under, the following table and figure.

TABLE VI

FABRIC THICKNESS

S.No	**Samples**	**Mean value (mm)**	**Gain/loss**	**Gain/loss percent**	**"F" Value**
1	OC	0.628	-	-	**1.902****
2	PC	0.256	0.372	59.2	
3	LTC	0.282	0.346	55.09	
4	STC	0.238	0.390	62.10	

**1%level significant

From the above Table it is clear that the fabric thickness was the maximum in the sample OC of 0.628mm. It was reduced in the samples PC, LTC and STC to 0.256mm, 0.282 mm and 0.238 mm respectively.

Hence, it could be concluded that after every treatment, the thickness of the fabric reduced gradually and reduction was the maximum in the sample STC of 62.10 percent.

The statistical data shows that there was a significant difference at 1% level with F value 1.902.

4.2. b FABRIC WEIGHT

The fabric weight for the original cotton fabric, pretreated and antimicrobial finished samples are presented under the following table and figure.

TABLE VII

FABRIC WEIGHT

S. No	Samples	Mean value (Gsm)	Gain/loss	Gain/loss percent	"F" ratio
1	OC	1.0514	-	-	**0.052****
2	PC	1.194	-0.142	13.5	
3	LTC	1.070	-0.0186	1.76	
4	STC	1.069	-0.0176	1.67	

**1% level significant

From the Table VII it is clear that the fabric weight of sample OC was 1.0514 gsm. This was reduced in samples PC, LTC and STC to 1.194gsm, 1.1.070 gsm and 1.069 gsm respectively. Hence, it could be concluded that the reduction in weight was gradual after every treatment and the maximum reduction of DC 13.5 percent was noted in the washed sample (Figure VII).

The statistical data shows that there was a significant difference at 1% level with F value of 0.052.

FIGURE I

Fabric Thickness

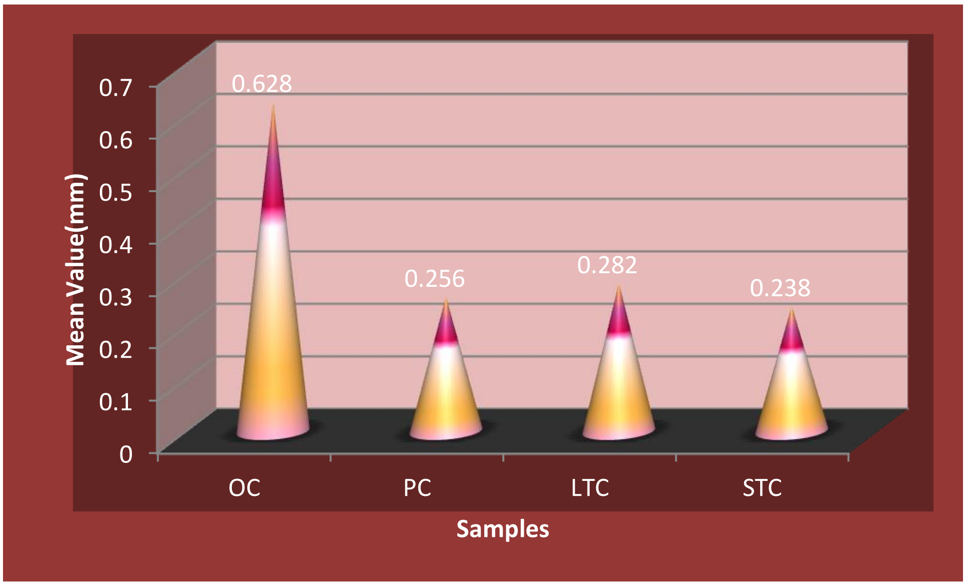
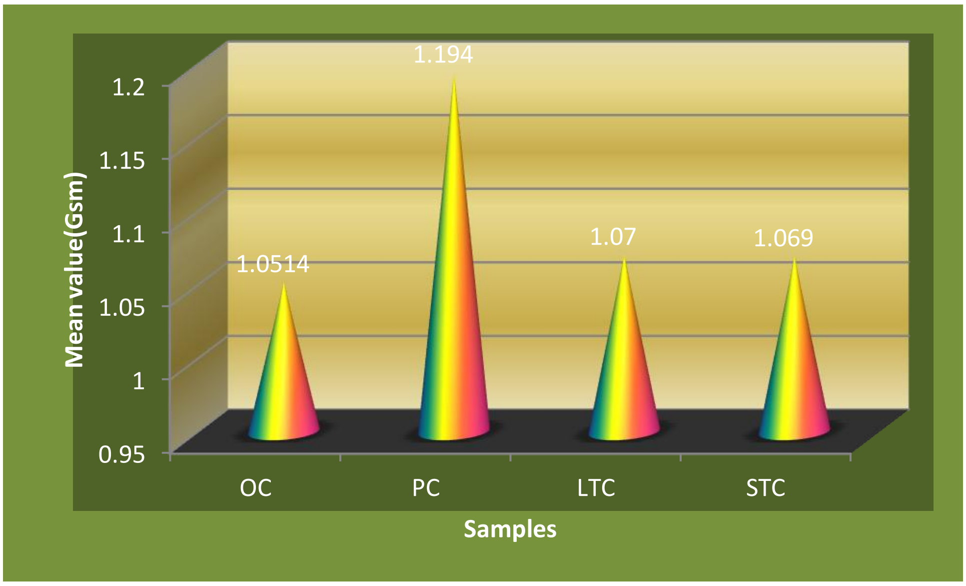


FIGURE II

Fabric Weight



4.3 ASSESSMENT OF MECHANICAL PROPERTIES

The salient mechanical properties of the original, pretreated and antimicrobial treated fabrics were analyzed.

4.3.1 Tensile strength and elongation

The evaluation of tensile strength and elongation of the fabrics both warp and weft direction are discussed under the following headings.

4.3.1.a.TENSILESTRENGTH OF FABRICS IN WARP DIRECTION

The tensile strength of original, pretreated and antimicrobial finished samples in warp direction is presented under the following table and figure.

TABLE VIII

TENSILE STRENGTH IN WARP DIRECTION (kg)

S. No	Samples	Mean Value	Gain/loss	Gain /loss	"F" Value
1	OC	56.2	-	-	**74.785****
2	PC	50.6	5.6	9.96	
3	LTC	37	19.2	34.1	
4	STC	37.4	18.8	33.4	

**1% level significant From the above Table it is obvious that the strength of samples in warp direction was the maximum in sample OC of 56.2 kg followed by samples PC a LTC and STC of 50.6 kg of 37 kg 37.4 kg. The strength was the maximum in untreated sample (Figure VIII).

The statistical data shows that there was a significant difference at 1% level with F value of 74.785.

4.3.1.b.TENSILESTRENGTH OF FABRICS IN WEFT DIRECTION

The tensile strength of original cotton, pretreated and antimicrobial finished samples in weft direction is presented under the following table and figure.

TABLE IX

TENSILE STRENGTH IN WEFT DIRECTION (kg)

S. No	Samples	Mean Value (kg)	Gain/loss	Gain /loss Percent	"F" Value
1	OC	49.4	-	-	**45.341****
2	PC	43.6	5.8	11.7	
3	LTC	29.6	19.8	40	
4	STC	35.2	14.2	28.7	

**1% level significant

From the Table it is clear that the strength of sample in weft direction was the maximum in original sample of 49.4 followed by the sample PC, LTC of 43.6, 29.6 and the sample STC showed reduction in strength of 35.2 percent.

The statistical data also proved that the was a significance difference level at 1% between original and finished sample with F value of 45.341

FIGURE III

Tensile Strength Warp

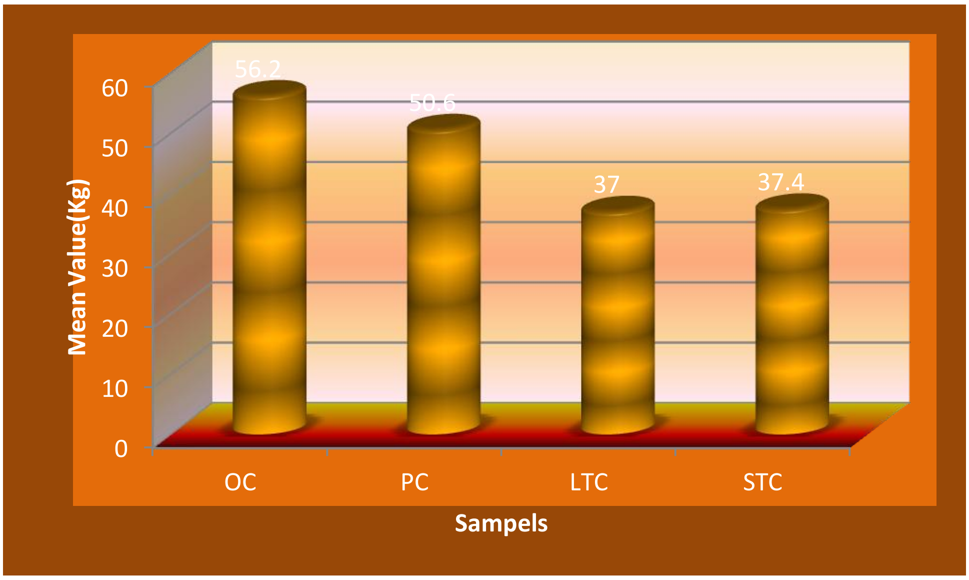
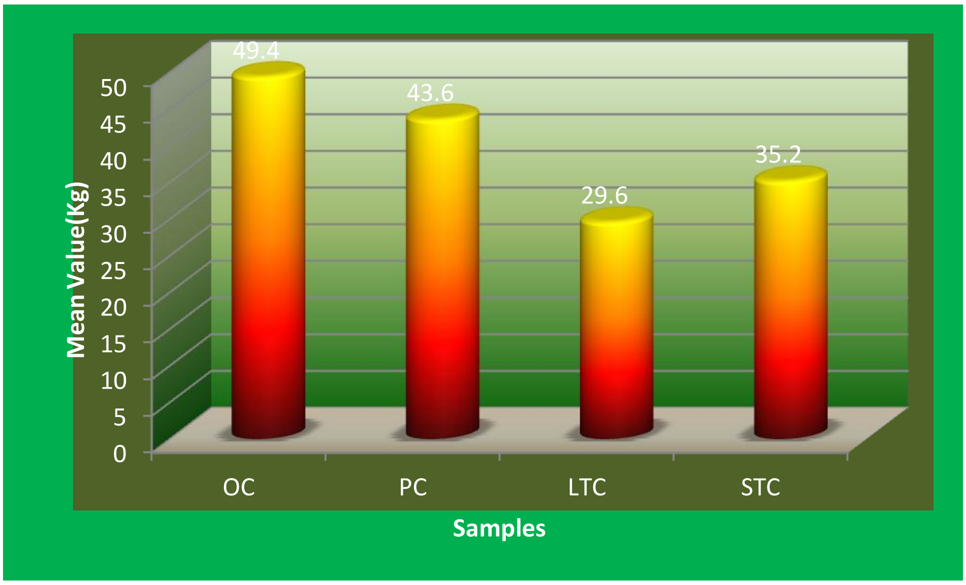


FIGURE IV

Tensile strength weft



4.3.1.c. ELONGATION OF FABRICS IN WARP DIRECTION

The elongation of original, pretreated and antimicrobial finished samples in warp direction is presented under the following table and figures.

Table X

ELONGATION OF FABRIC IN WARP DIRECTION (PERCENT)

S. No	Samples	Elongation (inches)	Gain /loss	Gain/loss Percent	"F" Value
1	OC	2.902	-	-	**122.02****
2	PC	2.7	0.202	6.96	
3	LTC	3.76	0.858	29.5	
4	STC	3.8	0.898	30.9	

**1% level significant

From the Table, it is clear that the elongation of fabric reduced drastically on OC to 2.902 percent but it was increased in sample LTC and STC to 3.76 and 3.8 respectively though these were lesser than the sample PC 2.7, (Figure XI).

The statistical data also proved significance at 1% difference between original and finished sample with F value of 122.20.

4.3.1. d. ELONGATION OF FABRICS IN WEFT DIRECTION

The elongation of original pretreated and antimicrobial samples in weft direction is presented under the following table and figures

TABLE XI

ELONGATION IN WEFT DIRECTION

S. No	Samples	Elongation (inches)	Gain/ loss	Gain/ loss Percent	"F" Value
1	OC	2.14	-	-	**224.341****
2	PC	1.9	0.24	11.2	
3	LTC	1.3	0.84	39.2	
4	STC	1.54	0.6	28.0	

**1%level significant

From the Table it is clear that the elongation value of PC samples is 1.9 LTC 1.3 and STC 1.54 over the it could original sample. Hence be concluded that the finishing source reduces the elongation in fabric.

The statistical data also proved that the was a significance difference level at 1% between original and finished sample with F value of 224.341.

FIGURE V

Elongation Warp

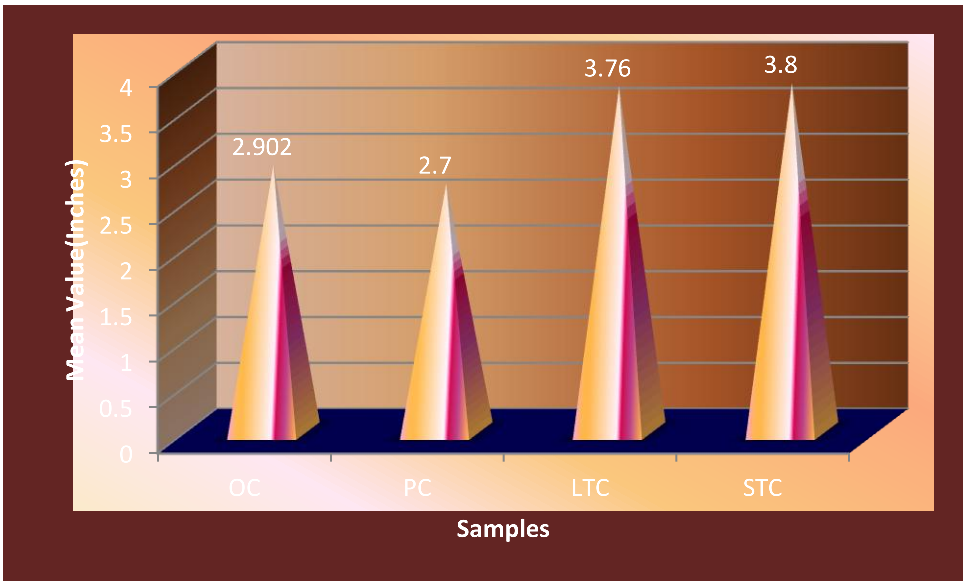
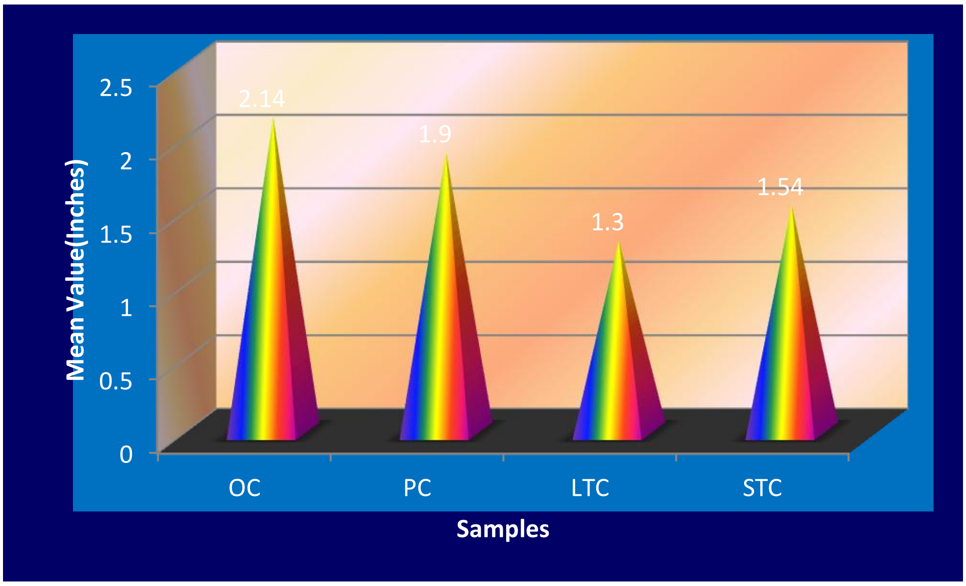


FIGURE VI

Elongation weft



4.3.1.e. ABRASION RESISTANCE

The evaluation results of the abrasion resistance original, pretreated and antimicrobial finished samples presented under the following table and figure.

TABLE XII

ABRASION RESISTANCE

S. No	Sample	Mean value	Gain/ loss	Gain/ loss Percentage	"F" Value
1	OC	800.6	-	-	**21.779****
2	PC	746	54.6	6.81	
`3	LTC	863.2	62.6	-7.81	
4	STC	884	83.4	-10.4	

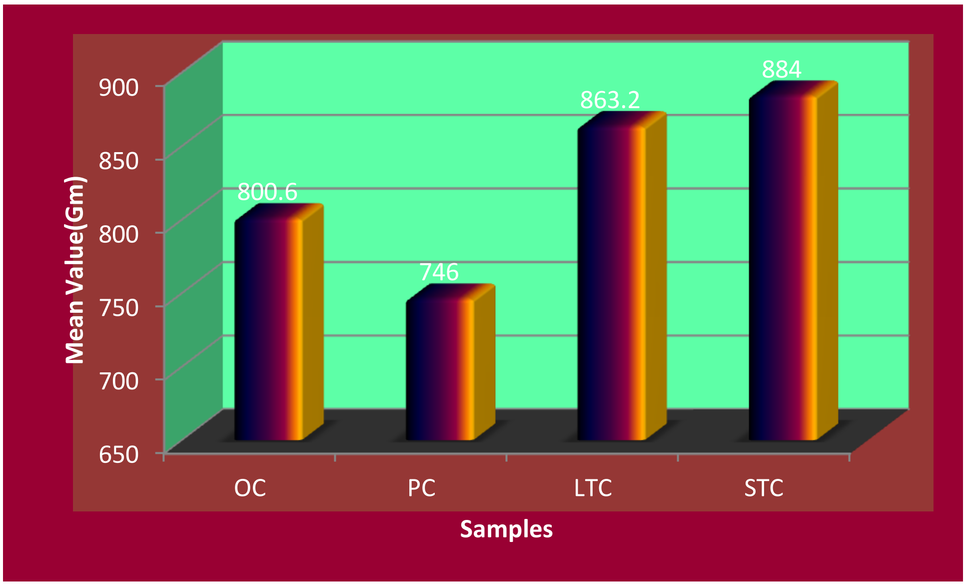
**1% level significant

From the Table it is understood that there was 6.81-percentage loss in the abrasion resistance capacity over original sample. There was difference noted 7.81, -10.4, among the samples LTC, STC.

The statistical data also proved that the was a significance difference level at 1% between original and finished sample with F value of 21.779.

FIGURE VII

Abrasion Resistance



4.3.1.f. PILLING TEST

The results obtained in the pilling tests carried for the original, pretreated and antimicrobial finished samples are presented under the table and figure.

TABLE XIII

PILLING OF FABRIC

SNo	OC	PC	LTC	STC
1.	4	4	5	4

4-slight pilling, 5- no pilling.

A slight pilling was observed in samples OC, and PC. In sample LTC there was no pilling and in the STC slight pilling was observed.

4.4. ASSESSMENT OF COMFORT PROPERTY

The comfort properties of the fabrics were analysed for stiffness, drape and crease recovery.

4.4.1.STIFFNESS OF FABRIC

The fabric stiffeness evaluated in warp and weft direction were presented under the following table and figure.

4.4.1.a. WARP DIRECTION (cm)

The results of the stiffness in warp direction is original, pretreated and antimicrobial finished samples are presented under the following table and figure.

TABLE XIV

STIFFNESS TEST OF FABRIC IN WARP DIRECTION (cm)

S. No	Samples	Mean value	Gain/ loss	Gain/ loss Percentage	"F" Value
1	OC	2.968	-	-	**63.185****
2	PC	2.54	0.428	14.42	
3	LTC	1.5	1.468	49.16	
4	STC	1.92	1.048	35.3	

**1% level significant

From the Table it is clear that the stiffness of the sample OC was 2.968 cm. This was gradually reduced in to 2.54 cm, 1.5 and 1.92 cm in samples PC, LTC and STC respectively.

Hence, it could be concluded that the stiffness reduction was the maximum in sample STC. The statistical data also proved that the was a significance difference level at 1% between original and finished sample with F value of 63.185.

4.4.1.b WEFT DIRECTION (cm)

The results of the stiffness in weft direction is original, pretreated and antimicrobial finished samples presented under the following table and figure.

TABLE XV

STIFFNESS TEST OF FABRIC IN WEFT DIRECTION (cm)

S. No	Samples	Mean value	Gain/ loss	Gain/ loss Percentage	"F" Value
1	OC	2.72	-	-	**85.021****
2	PC	1.9	0.82	30	
3	LTC	1.3	1.42	52	
4	STC	1.54	1.18	43	

**1% level significant

From the table it is clear that the stiffness of fabric was 2.72cm in the sample OC. This was gradually reduced in to 1.9cm, 1.3cm and 1.54 in the samples PC, LTC and STC respectively.

Hence, it could be concluded that the stiffness reduction was the maximum in sample LTC. The statistical data also proved a significant difference 1% between the original and the finished samples with F value of 85.021.

FIGURE VIII

Stiffness Warp

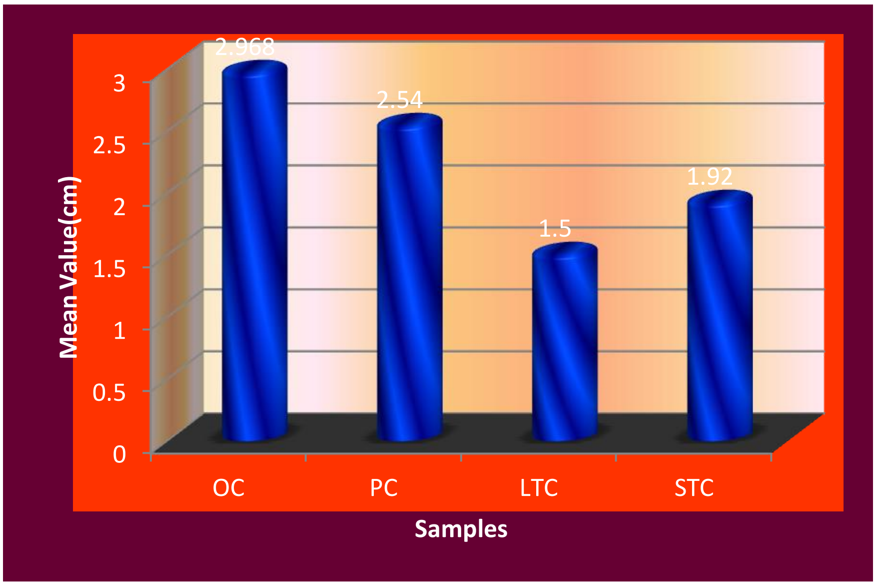
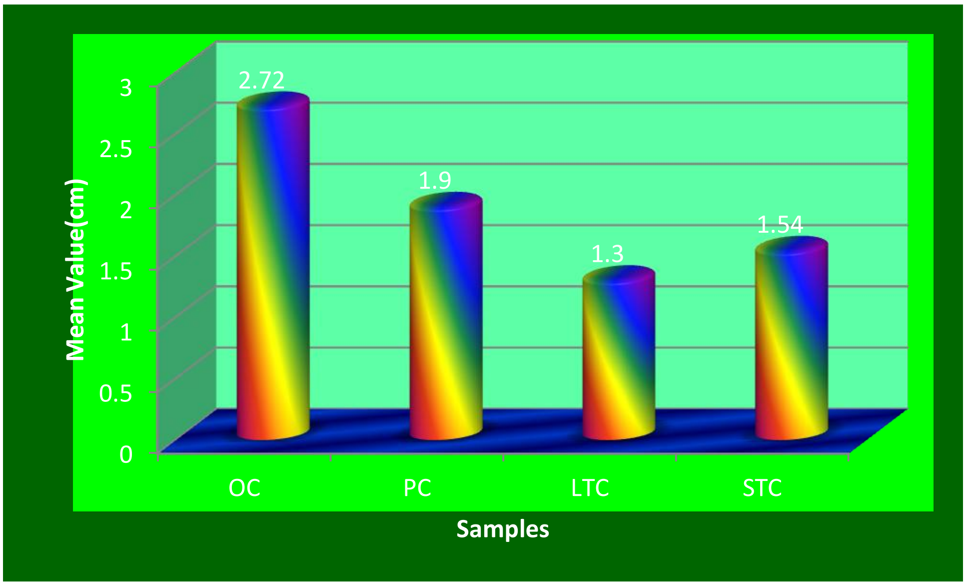


FIGURE IX

Stiffness Weft



4.4.1.c.FABRIC DRAPE

The results of the drape coefficient of fabric are expressed in Table XVII

TABLE XVI

DRAPE COEFFICIENT OF FABRIC (%)

The results of the drape coefficient of fabric is original, pretreated and antimicrobial finished samples are presented under the following table and Figure.

TABLE XVI

DRAPE COEFFICIENT OF FABRIC

S. No	Samples	Drape coefficient	Gain/loss	Gain/loss percent	"F" ratio
1	OC	0.870	-	-	**1.907****
2	PC	0.87	0	0	
3	LTC	0.583	0.287	32.9	
4	STC	0.555	0.315	36.20	

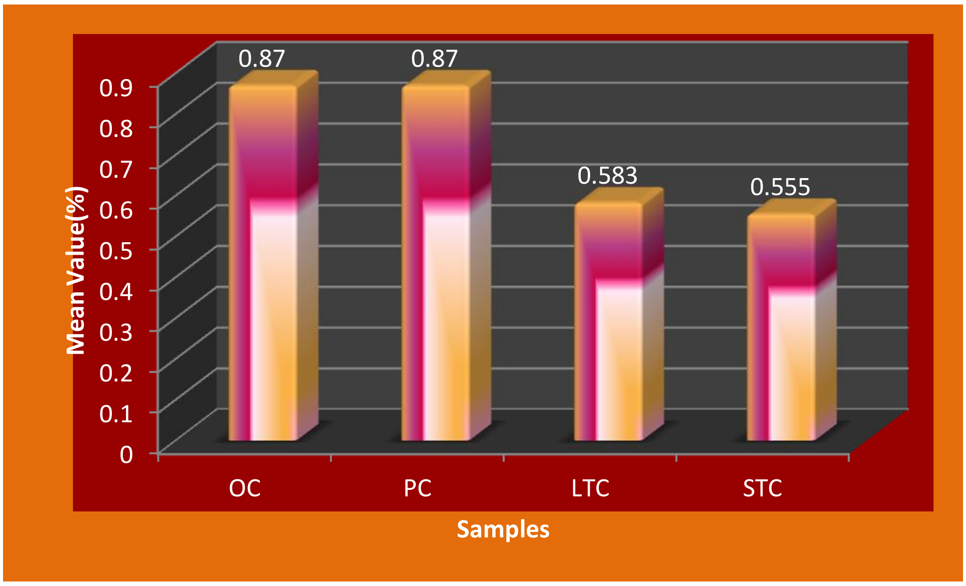
. **1% level significant

From the table it is clear that the drape coefficient is the maximum in the sample OC of 0.870 per cent followed by samples PC, LTC, and STC of 0.87, 0.583 and 0.555 percentages respectively.

More the coefficient higher will be the drapebility of the fabric. The statistical value also proved a significance of 1% difference with F value of 1.907.

FIGURE X

Fabric Drapebility



4.5. ABSORBENCY TESTS

The results of the absorbency tests carried out for the original, pretreated and antimicrobial finished fabrics in both warp and weft directions are expressed under.

4.5. a. WICKING TEST

The result of wicking of fabric is original, pretreated and antimicrobial finished samples are presented under the following table and figure.

TABLE XVII

WICKING IN WARP AND WEFT DIRECTIONS (cms)

S. No	Samples	Wicking (cm)	Gain/loss	Gain/loss value Percentage	"F" Value
1.	OC	3.26	-	-	**88.930****
2.	PC	3.6	-0.34	10.42	
3.	LTC	5.78	-2.52	-77.3	
4.	STC	5.66	-2.4	-73.6	

**1% level significant

From the Table it is observed that the wicking was 3.26 cms in the sample OC. It was the highest in sample LTC of 5.78cms followed by the sample PC and STC of 3.6 and 5.66 respectively.

Hence, it could be concluded that the capillary movement of the water was faster in the treated and finished samples than the original sample in both warp and weft directions.

The statistical data also proved a significance of 1% difference with F value of 88.930.

4.5. b. SINKING TEST

The result of sinking test of original, pretreated and antimicrobial finished samples is presented under the table and figure.

TABLE XVIII

SINKING IN WARP AND WEFT DIRECTIONS (cm)

S. No	Samples	Mean value (seconds)	Gain/Loss	Gain/Loss percentage	"F" value
1	OC	1.18	-	-	**45.807****
2	PC	1.52	0.34	28.8	
3	LTC	1.78	0.6	50.8	
4	STC	1.82	0.64	54.2	

**1% level significant

From the Table it is clear that the sinking speed was the maximum in sample STC of 1.82 seconds followed by samples PC and LTC of 1.52 seconds and 1.78 seconds.

Hence, it could be concluded that the absorbency rate increased in all the antimicrobial treated samples over original sample. The maximum absorbency was noted in STC of 54.2 per cent cross over original sample (Figure XIX).

The statistical data also proved that the was a significance difference level at 1% between original and finished sample with F value of 45.807.

FIGURE XI

Wicking Test

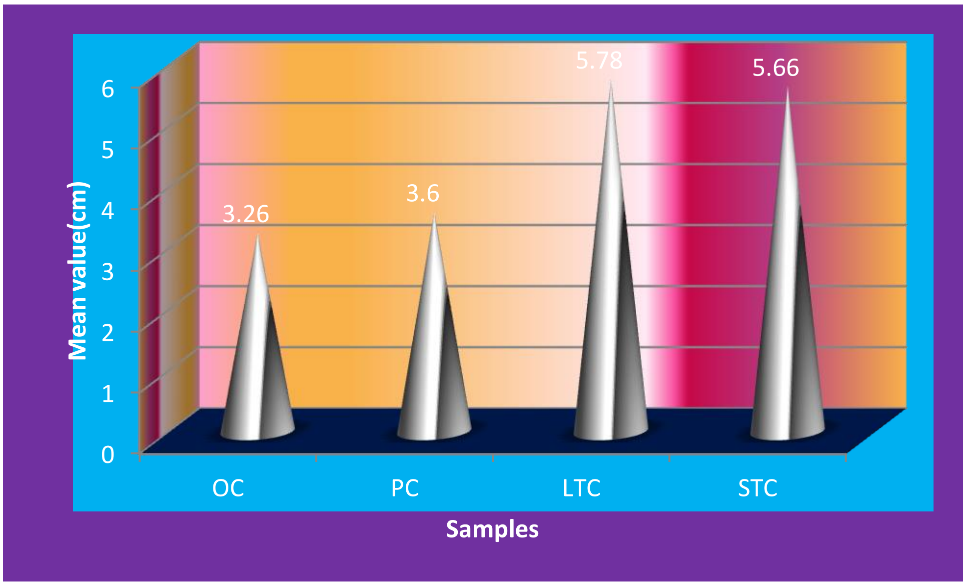
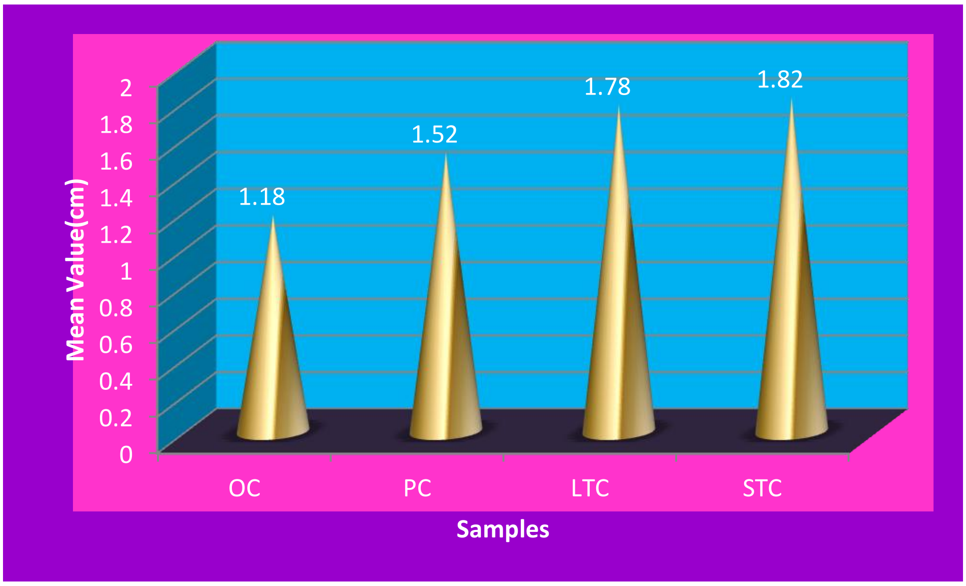


FIGURE XII

Sinking Test



4.5. c. DROP TEST

The result of Drop test of original, pretreated and antimicrobial finished samples is presented under the following table and figure.

TABLE XIX

DROP TEST (seconds)

S. No	Samples	Mean value (seconds)	Gain/ loss	Gain/ loss Percentage	"F" Value
1	OC	39	-	-	**82.543****
2	PC	24	15	38.4	
3	LTC	2.24	36.76	94.2	
4	STC	2.32	36.68	94.0	

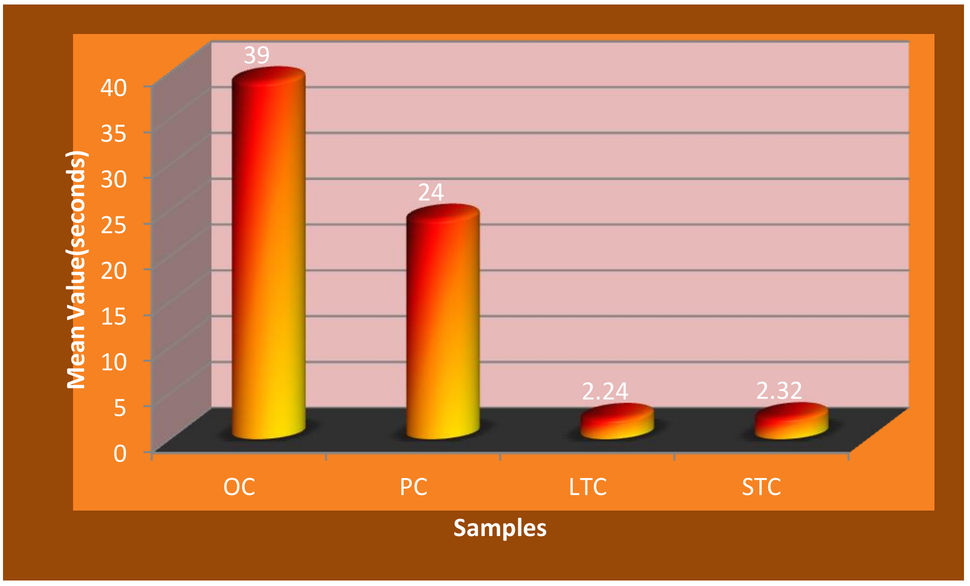
** 1% level significant

From the Table it is obvious that the time taken by the water droplet to penetrate into the fabric was 39 seconds in sample OC whereas it showed a reduction in time in the antimicrobial finished samples. The maximum reduction was noted in sample LTC 94.2 percent followed by samples PC and STC of 38.4 percent and 94.0 per cent respectively.

The statistical data also proved that the was a significance difference level at 1% between original and finished sample with F value of 82.543.

FIGURE XIII

Drop Test



TABEL XX

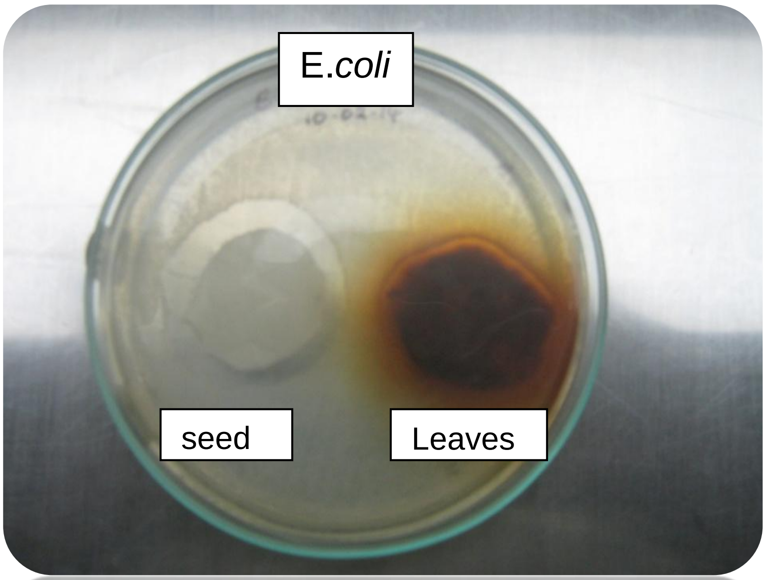
4.6. ANTIMICROBIAL RESULT

S.No.	Organisms	Zone of Inhibition Crud extract (mm)	Zone of Inhibition In soxhlet extraction
1	E. coli	12 mm	8 mm
2	S. aurous	8 mm	7mm
3	Candida fungi	-	9 mm

Antimicrobial test was carried and in crude extract and soxhlet extract form. The test revealed that E.coli formation in crude and sox let extraction was 12mm and 8mm respectively, speces of s.aurous in crude extract was 8 mm and then the soxhlet extract was 7mm. The same procedure was carried out for the fungi Candida to find out the zone of inhibition. The soxhlet extract shows 9 mm zone of inhibition.

PLATE XVII

Antibacterial activity crude extract



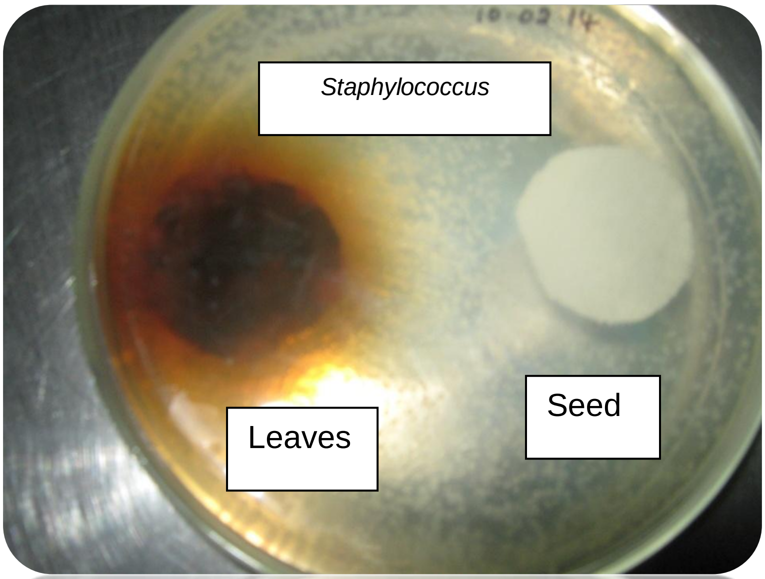
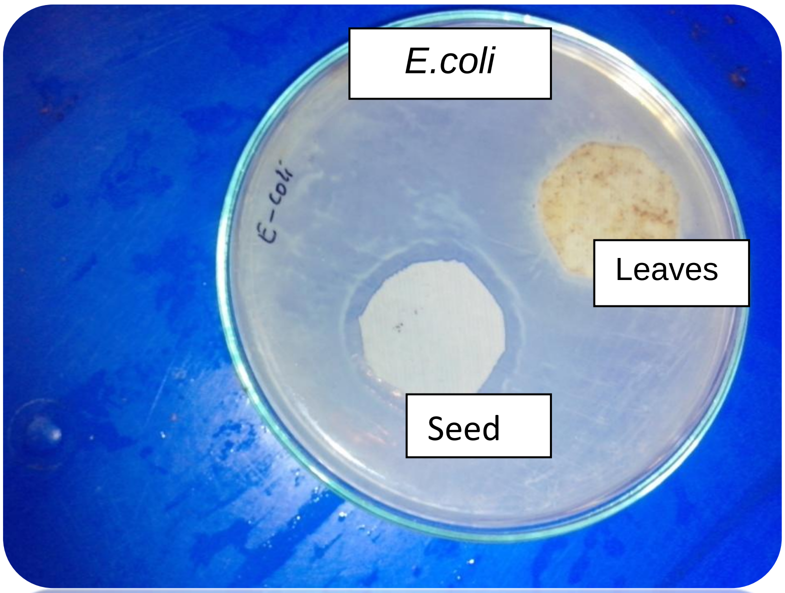


PLATE XVIII

Antibacterial activity soxhlet extract



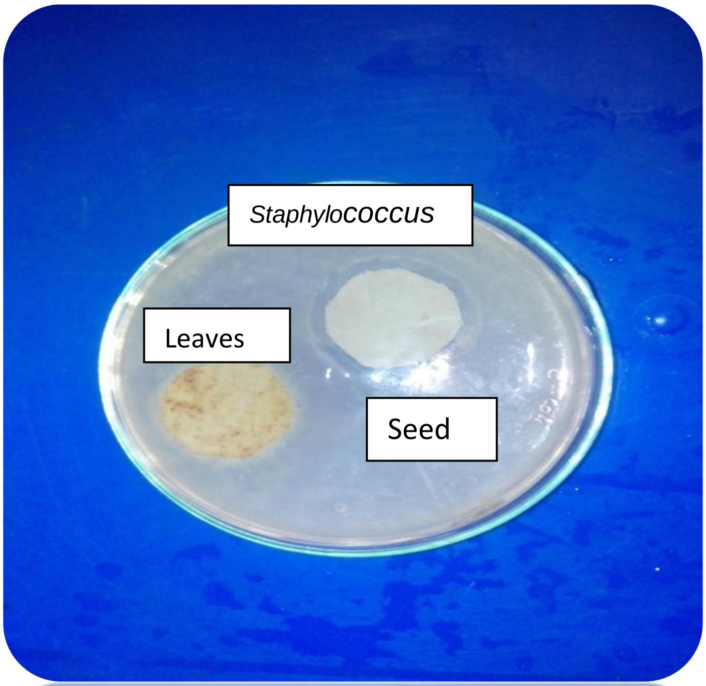


PLATE XIX

Antifungal activity of annona leaves and seeds

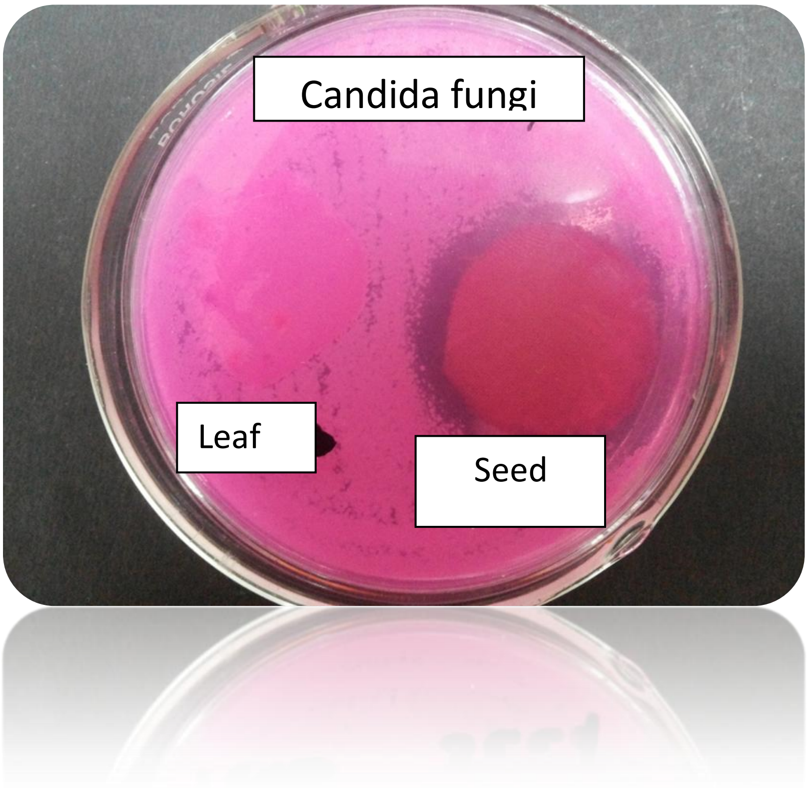


PLATE XX

END PRODUCT BED LINEN

CHAPTER V

5. SUMMARY AND CONCLUSIONS

The textile industry is undergoing a major reorientation towards non-clothing applications of textiles, known as technical textiles, which are growing roughly at twice rate of textiles for clothing applications and now account for more than half of total textile production. The processes involved in producing technical textiles require expensive equipments and skilled workers and are, for the moment, concentrated in developed countries. Technical textiles have many applications including bed sheets; filtration and abrasive materials; furniture and healthcare upholstery; thermal protection and blood-absorbing materials; seatbelts; adhesive tape, and multiple other specialized products and applications. The Indian Textile industry has been undergoing a rapid transformation and is in the process of integrating with the world textile trade and industry. The progressive dismantling of the MFA and the imperative of the recently signed General Agreement Trade & Tariff are driving this change. In this bold, new scenario, India has to move beyond its role of being a mere quota satisfying country.

Finish would mean modification of the fabric surface to meet certain desired needs or specifications, application of certain additives, softeners, stiffeners, and resins. In general, Finishing is done to the textiles subsequent to the fabrication.

Many medicinal plants are considered potential antimicrobial crude drugs as well as a source for novel compounds with anti-microbial activity, with possibly new modes of action. This expectation that some naturally occurring plant compounds can kill antibiotic-resistant strains of bacteria such as *Bacillus cereus*, *Escherichia coli*, *Micrococcus luteus* and *S. aureus* has been confirmed

Medical textiles remain one of the most dynamic areas of research in textiles. *Medical and healthcare textiles* are the fourth in a series of conferences held at the University of Bolton. Like its predecessors, it has attracted papers from some of the leading international centers of expertise in the field. Contributors cover a range of topics including emerging textile-based biomaterials, hygienic textiles, the use of textiles in infection control and as barrier materials, bandaging and pressure garments for managing chronic infections such as ulcers, the role of textiles in the management of burns and wounds, textile-based implantable devices such as tissue scaffolds and sutures, and intelligent textiles.

Antimicrobial textiles are easily finding a place in the global textile market. Their end users can be tailored to fit the needs of many different people and their professions. Most antimicrobial experimentation is being performed for the medical industry. The apparel industry can definitely benefit from this experimentation because the products made for the two professions are closely related. The number of safe and durable antimicrobial finishes is steadily growing. An emphasis is being put on the use of fabrics made of natural fibers because the global economy is trying to reduce the overall use and production of petroleum-based products (synthetic fibers). The global trend for a safer environment is apparent all around us.

Considering above facts the investigator selected the research work on the topic, "**Comparative study on Antimicrobial Property of *Annona squamosa L.* leafs and seeds**" with following objectives.

- To select herbs for antimicrobial finishes
- To optimize, parameters required for the finish
- To select the finishing technique
- To study the standard testing method for antimicrobial activity
- To produce the end product from the finished fabric

Experimental procedure

- ### Selection of Fabric

  The grey cotton fabric was selected for the study.

- ### Preparation of the fabric

  The fabric was prepared by desizing, scouring, and bleaching treatments to remove the sizing material and impurities adhere to the fabric.

- ### Preparation of Leaf And Seed Extract

  - The leafs and seeds materials were grounding a grinding machine in the laboratory then 30g of shade-dried powder was weighed and extracted successively with ethanol in soxhlet extractor for 48h. The ethanol extracts were concentrated under reduced pressure and preserved in refrigerator in airtight bottle for further use.

- The dried powder samples of extracted with ethanol (300 mL) using Soxhlet extractor for 48 hours until complete extraction. After extraction, it was filtered and evaporated by rotary evaporator to give amophorous solid masses. The crude extract (1.5g g) the crude extracts was transferred into a separator funnel.
- The fabric was objectively analyzed for thickness, weight, strength and elongation, abrasion resistance, pilling, stiffness, wicking, sinking and Drop test.

FINDINGS OF THE STUDY

- The sample enhanced its general appearance on finishing. Texture improved as soft. Evenness of fabric was excellent by finishing. The brilliancy of whiteness reduced in the finished sample due to the adherence of color on treatment with *Annona Squamosa* seed and leaf extract.
- Thickness of the fabric reduced gradually after every treatment and reduction was the maximum in the finished sample STC is 0.238.
- Weight was gradually reduced after every treatment and the maximum reduction was noted in the finished sample LTC is 1.070.
- In warp direction, the fabric lost its strength on finishing sample LTC is 37.
- In weft direction, the fabric lost its strength on finishing sample LTC is 29.6.
- The fabric gained its elongation capacity in warp direction on pretreated sample PC is 2.7.
- The fabric lost its elongation capacity in weft direction on finishing sample OC is 2.14.
- The abrasion resistance in fabric raised on finishing sample STC is 884.
- Slight pilling was noted in the original and pretreated samples. On finishing, the pilling was enriched in the fabric maximum pilling LTC is 5.
- The stiffness reduction was the maximum in warp and weft direction antimicrobial finish sample reduced stiffness slightly in the fabric. maximum in warp direction sample is OC 2.968. Then weft direction maximum value is OC 2.72.

- The drapeability of the fabric reduced in the pretreated, antimicrobial finished samples over the original sample. The maximum sample is OC is 0.870.
- The capillary movement of the water was faster in the antimicrobial finished samples than the original sample in both warp and weft directions. The maximum sample is LTC is 5.78.
- The absorbency rate decreased in all the treated samples over original sample. The maximum absorbency was noted in original sample is OC is 39.
- The statistical analysis also found that there was a significant difference in the tests namely thickness, strength, abrasion, stiffness, crease recovery, drape, sinking and drop at one percent level

Conclusion

Annona squamosa is the best for antimicrobial agent from seed and leaves suitable extract. Annona seedextarct have great potential for antimicrobial finish. The natural antimicrobial finish shows good microbes resistant which are non-toxic, non-allergitic, non-skin irritant and also Eco-friently. When applied to the cotton fabric. from this study it was concluded that, the antimicrobial activity greater in *annona* seeds and it was exellent fabric property. Such as weidht, streangth, drape , stiffeness, and absorbency testes. Compared which A.leaves, A.seeds showed maximum antimicrobial activity.

Recommendations

- The samestudy could be dried on different varieties of natural fabric and meditional plants.
- A comparative study can be made with different extraction method.
- The antimicrobial activity could be suitable with latest techniques, like nano finish, microencapsulation etc.
- The same study can be done on knitted and nonwoven fabrics.

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