Investigation of resistant to microbial substances for 100% Cotton Knitted fabric treated with water & methanol extracts from Punica granatum fruit and its influence on physical properties

Kamrul Hasan[1], Mohammad Neaz Morshed[2], Ashraful Islam[3*], Mohammad Amir Hamzah[4], Md. Kamrul Hasan Munna[5]

Abstract —Along with ease and aesthetic properties resistant to microbial substance is one of the prioritize parameter for textile and clothing materials. “The consumers are now increasingly aware of the hygienic life style and there is a necessity and expectation for a w ide range of textile products finished with antimicrobial properties”, says O L Shanmugasundaram. With a profound literature analysis and reference, in this study the water and methanol extracts of Punica granatum fruit was obtained and treated with 100% cotton fabric. The fabrics were tested for its antibacterial activity against bacterial strains like Staphylococcus aureus, Escherichia coli, Klebsiella pneumoniae, Proteus vulgaris, and Salmonella tophi. Earlier works was mainly focused on results of this method for cotton woven fabric, but not labelled its influence on knitted fabric and its physical possessions, in this study the consequence has been investigated for knitted fabric (Double Lacoste) along with different type of physical tests as like Color fastness to wash, Color fastness to Rubbing, Strength, Busting and Agaric Diffusion test etc. The result indicates an unblemished microbial resistance of treated knitted cotton fabric by using Gromophenal. Treated samples showed better result in hand feel property than the untreated samples. Shade variation has been found from the treated sample to untreated sample.

Key Words —Methanol. Punica granatum, Agar diffusion method, Physical tests, microbial resistance, Knitted fabric.

1. INTRODUCTION

Owing to the increasing demand for comfortable, uncontaminated, and germ-free textile goods and chattels, an urgent need for invention of antimicrobial textile goods has get to your feet. With the arrival of new know-hows, the growing needs of consumers in terms of health and hygiene can be fulfilled without compromising issues related to safety, human health, and the environment. Health and hygiene are the primary requirements for human beings to live comfortably and work with maximum efficiency.

- *1,2,4Masters in Textile Engineering, School of Textile Science & Engineering, Wuhan Textile University, Wuhan, Hubei, P.R. China.*
- *3,5Masters in dyeing and finishing, School of Chemistry and Chemical Engineering, Wuhan Textile University, Wuhan, Hubei, P.R. China.*
- **Corresponding author E-mail: ashrafulislam73@gmail.com*

Various well-designed ability for the antimicrobial property of textile materials were being considered to be significant clothing, which are in uninterrupted dealings with human body [1]. Biological compound presents in the cellulosic fiber can act as a nutrient for the growth of microorganism [2]. The progress of microorganism in apparel causes unpleasant fragrance, staining, loss of mechanical strength etc., and also cause health related problem to the wearer. However it is vital to provide necessary protection to the wearer from the bacteria; the fabric must have the bacterial resilient properties [3]. There are numerous antimicrobial agents used to develop the functional ability of the apparel material. But recently there are lot of attraction towards natural based herbs as an antimicrobial agent because of its eco-friendly and health hazardless. *Punica granatum L.* has been widely used by traditional medicine in America, Asia, Africa and Europe for the treatment of different types of diseases [4] [5] [6] [7]. It has been highlighted in many studies as having antimicrobial activity against a range of both Gram positive and negative bacteria. The fruits of Punica granatum (pomegranate) have been used to treat acidosis, dysentery, microbial infections, diarrhoea, helminthiasis, haemorrhage, and respiratory Pathologies [9]. Melendez and Capriles have also reported that extracts from Punica granatum fruits possess strong in vitro antibacterial action against many microbial strains tested [10]. Numerous studies have shown that the pomegranate peel extract has wound healing properties. Antibacterial activity, antifungal activity and antimicrobial effect.

Punica granatum is an important medicinal plant in medicine and it is most frequently used herb in Ayurveda1. Punica granatum is called the „King of Medicine" in Tibet and is always listed at the top of the list in Ayurvedic Material due to its extraordinary power of healing [4]. The dried ripe fruits of Punica granatum has traditionally been used in the treatment of asthma, sore throat, vomiting, hiccough, diarrhoea, bleeding piles, go out, heart and bladder diseases [4]. Punica granatum is routinely used as traditional medicine by tribal of Tamil Nadu in India to cure several ailments such as fever, cough, diarrhea, gastroenteritis, skin diseases, candidiasis, and urinary tract infection and wound infections. Antibacterial action of Punica granatum extracts in contradiction of several bacterial strains has been testified [1].

The present investigation aims at evaluate a sustainable natural antimicrobial finish from plant extracts for textile use. For this study one plant (Punica granatum) was selectively taken based on the literature. The methanol and water extracts of the material were treated on cotton textile and the efficacy of microbial resistance of the textile material were investigated and then several physical test was conducted to assess its influence on physical properties.

2. Literature Review

2.1 General interpretation

This themes is to discover & congregated all evidence's in order to understand undoubtedly about the different types of natural antimicrobial finishing agent and their various applications. The evidence's is come from mentioned books, online blogs, journals & thesis. These matters are mainly alarmed with allied knowledge of different type of tests as well as analysis about antimicrobial textiles.

2.2 Different types of Antimicrobial Finishing Agent Source.

Thomsan Research Associates markets a range of antimicrobials under the trade name Ultrafresh for the textile and polymer industry [15]. Ultra fresh products were developed to be used in normal textile processes. Most ultra-fresh treatments are non-ionic and are compatible with a wide range of binders and finishes. To incorporate antibacterial into high temperature fibers like polyester and nylon, it is necessary to use an inorganic antimicrobial like Ultra fresh CA-16 or PA-4215. These must be added as a special master batch to the polymer mixture before the extrusion process.

For fibers such as polypropylene, which are extruded at lower temperatures, it is possible to use organic antimicrobials such as Ultra fresh Nm-100, Dm-50 or XQ-32. In the case of Rossari.s Fabshield with AEGIS microbe shield program, the cell membrane of the bacteria get ruptured when the microbes come in contact with the treated surface; thus, preventing consumption of antimicrobial over a period of time and remain functional throughout the life of the product. The active substance 3-Trimethoxy silyl propyl dimethyl octadecyl ammonium chloride gets attached to the substrate either through bond formation on the surface or by micro polymer-sing and forming a layer on the treated surface; the antimicrobial agent disrupts the cell membrane of the microbes through physical and ionic phenomena.

Ciba Specialty Chemicals markets Tinosan AM 110 [15] as a durable antimicrobial agent for textiles made of polyester and polyamide fibers and their blends with cotton, wool or other fibres. Tinosan contains an active antimicrobial (2, 4, 4'-Trichloro-2' - hydroxyl-dipenylether) which behaves like a colourless disperse dye and can be exhausted at a very high exhaustion rate on to polyester and polyamide fibers when added to the dye bath.

Clariant markets the Sanitised range of Sanitized AG [15], Switzerland for the hygienic finish of both natural and synthetic fibres. The branded Sanitised range function as a highly effective bacteriostatic and fungistatic finishes and can be applied to textile. Brentano's polyurethane faux leathers include an antibacterial finish that is added to the polyurethane compound before it is poured. The active component of the treatment is a silver ion that bonds to the substances bacteria need for respiration. This form of antibacterial finish is widely recognized as one of the least harmful for human health materials such as ladies hosiery and tights. Along with them there are several antibacterial agents whose are extruded from fruits.

2.3 Antimicrobial textiles

Actigard finishes from Clariant are used in carpets to combat action of bacteria, house dust mites and mould fungi. Avecia.s Purista-branded products treated with Reputex 20 which is based on poly (hexamethylene) biguanide hydrochloride (PHMB) demanded to possess a low mammalian harmfulness and broad spectrum of antimicrobial activity. PHMB is particularly suitable for cotton and cellulosic textiles and can be applied to blends of cotton with polyester and nylon. In addition to the aforesaid antimicrobial agents, the fibres derived from synthetic with built-in antimicrobial properties are listed in Table 1 [14].

TABLE 1
Antimicrobial fiber on the basis of synthetic polymers

Antimicrobial fibre on the basis of synthetic polymers

Polymer	Company	Brand
Polyester	Trevira	Trevira Bioactive
	Montefibre	Terital SANIWEAR
	Brilen	Bacterbril
Polyacryl	Accordis	Amicor
	Sterling	Biofresh
Polyamide	Kaneba	Livefresh
	R-STAT	R-STAT
	Nylstar	Meryl Skinlife
Polypropylene	Asota	Asota AM Sanitary
Polyvinyl chloride	Rhovyl	Rhovyl's asAantibacterial
Regenerated cellulose	Zimmer AG	Sea Cell Activated

3. Theoretical Methods

3.1 What are microbes or microorganisms?

Microbes are single-cell beings so small that millions can fit into the eye of a needle. They are the oldest form of life on earth. Microbe remains date back more than 3.5 billion years 13 to a time when the Earth was enclosed with oceans that regularly reached the boiling point, hundreds of millions of years before dinosaurs roamed the earth. Without microbes, we couldn't eat or breathe. Without us, they'd probably be just fine. Understanding microbes is vital to understanding the past and the future of ourselves and our planet. Microbes are everywhere. There are more of them on a person's hand than there are people on the entire planet. Microbes are in the air we breathe, the ground we walk on, the food we eat—they're even inside us [13]. Human couldn't digest food without them—animals couldn't, either. Without microbes, plants couldn't grow, garbage wouldn't decay and there would be a lot less oxygen to breathe. In fact, without these invisible companions, our planet wouldn't survive as we know it [13].

A microorganism is a microscopic active organism, which may be single celled [10] or multicellular. The study of microorganisms is called microbiology.

Microorganisms are very miscellaneous and includes all the bacteria, archaea and almost all the protozoa. They also include some fungi, algae, and certain animals, such as rotifers. Many macroscopic animals and plants have microscopic juvenile stages. Some microbiologists also categorize viruses as microorganisms, but others reflect these as nonliving [11], [12].

3.2 Sources of microbes

Following are source [17] of microbes,

- In the air we breathe.
- In the soil.
- In our skin and bodies.
- Everywhere.

3.3 Ideal Conditions For microbial Growth

After a profound survey it shows that following [17] are ideal condition for microbial growth,

- Food.
- Warm temperature.
- Moisture (Humidity, Spills).
- Receptive surface (skin, fabric)

3.4 What are Antimicrobials?

Drugs that destroy microbes, prevent their multiplication or growth, or prevent their pathogenic action [14],

- Differ in physical, chemical, pharmacological properties
- Differ in antibacterial spectrum of activity
- Differ in their mechanism of action

3.5 Antimicrobial Finishes

The inherent properties of the textile fibers provide room for the growth of microorganisms. Besides, the structure of the substrates and the chemical processes may induce the growth of microbes. Humid and warm environment still aggravate the problem. Infestation by microbes cause cross infection by pathogens and development odour where the fabric is worn next to skin [15]. In addition, the staining and loss of the performance properties of textile substrates are the results of microbial attack. Basically, with a view to protect the wearer and the textile substrate itself antimicrobial finish is applied to textile materials.

3.6 Necessity of Antimicrobial Finishes:

Antimicrobial treatment for textile materials is necessary to fulfill the following objectives [15]:

- To control microorganisms.
- To reduce odor from perspiration, stains and other soil on textile material.
- To reduce the risk of cross infection being carried by feet from ward to ward in hospital.
- To control spread of disease and danger of infection following injury.
- To control the deterioration of textiles particularly fabrics made from natural fiber caused by mildew

3.7 Requirements for Antimicrobial Finish

Textile materials in particular, the garments are more susceptible to wear and tear. It is important to take into account the impact of stress strain, thermal and mechanical effects on the finished substrates. The following requirements [15] need to be satisfied to obtain maximum benefits out of the finish:

- Durability to washing, dry cleaning and hot pressing.
- Selective activity to undesirable microorganisms.
- Should not produce harmful effects to the manufacturer, user and the environment.
- Should comply with the statutory requirements of regulating agencies.
- Compatibility with the chemical processes.
- Easy method of application.
- No deterioration of fabric quality.
- Resistant to body fluids.
- Resistant to disinfections/sterilization.

3.8 Antimicrobial Finishing Methodologies

The antimicrobial agents can be applied to the textile substrates by exhaust, pad-dry-cure, coating, spray and foam techniques. The substances can also be applied by directly adding into the fiber spinning dope. It is claimed that the commercial agents can be applied online during the dyeing and finishing operations. Various methods for improving the durability of the finish include [15]:

- Insolubilisation of the active substances in/on the fiber.
- Treating the fiber with resin, condensates or cross linking agents.
- Icro encapsulation of the antimicrobial agents with the fiber matrix.
- Coating the fiber surface.
- Chemical modification of the fiber by covalent bond formation.
- Use of graft polymers, homo polymers and/or co polymerization on to the fiber.

3.9 Mechanism of Antimicrobial Activity

The mechanisms by which compounds with antibacterial activity inhibit growth or cause bacterial death are varied and depend on the affected targets. The bacterial cell wall-a unique structure in most bacteria that is absent in eukaryotic cells-can be affected in several ways: at different stages of synthesis (fosfomycin, cycloserine) or transport (bacitracin, mureidomycins) of its metabolic precursors, or by a direct action on its structural organization (beta-lactams, glycopeptides) [16]. The differentiation of antimicrobial activity is given in the diagram[16] (Figure 1).

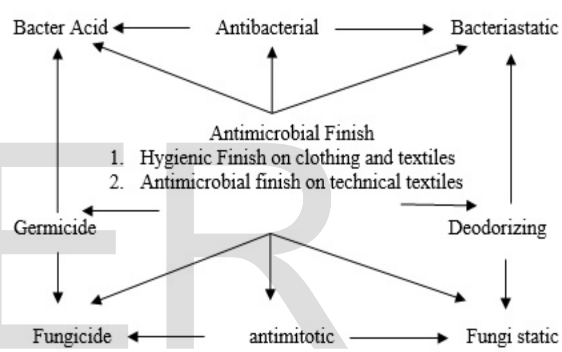

Figure 1: Diagram of Mechanism of Antimicrobial Activity

The activity, which affects the bacteria, is known as antibacterial and that of fungi is antimitotic [14]. The antimicrobial substances function in different ways. In the conventional leaching type of finish, the species diffuse and poison the microbes to kill. This type of finish shows poor durability and may cause health problems. The non-leaching type or bio-static finish shows good durability and may not provoke any health problems. A large number of textiles with antimicrobial finish function by diffusion type. The rate of diffusion has a direct effect on the effectiveness of the finish. For example, in the ion exchange process, the release of the active substances is at a slower rate compared to direct diffusion ad hence, has a weaker effect. Similarly, in the case of antimicrobial modifications where the active substances are not released from the fiber surface and so less effective. They are active only when they come in contact with

microorganisms [14]. Considering the medical, toxicological and ecological principles has developed these so called new technologies.
The antimicrobial textiles can be classified into two categories [14], namely, passive and active based on their activity against microorganisms. Passive materials do not contain any active substances but their surface structure produces negative effect on the living conditions of microorganisms.

3.10 Antimicrobial Function & Adaptation

Antimicrobials first and foremost purpose in two different ways. The conservative filtering types of antimicrobials leave the textile and chemically enter or react with the microorganism acting as a poison. The unconventional bound antimicrobial stays affixed to the textile and, on a molecular scale, physically stabs (the membrane) and electrocutes (the biochemical in the membrane) the microorganism on contact to kill it. Like an arrow shot from a bow or bullet shot from a gun, leaching antimicrobials are often effective, but they are used up in the process of working or wasted in random misses. Some companies incorporate leaching technologies into fibers and slow the release rate to extend the useful life of the antimicrobial or even add them to chemical binders and claim they are now "bound". Whether leaching antimicrobials are extruded into the fiber, placed in a binder or simply added as a finish to fabrics or finished goods, they all function the same. In all cases leaching antimicrobial technologies provide a killing field or "zone of inhibition". This zone exists in real-world uses if it is assumed that the right conditions exist for leaching of a lethal dose at the time that it is needed. The zone of inhibition is the area around the treated substrate into which the antimicrobial chemistry leaches or moves to, killing or inhibiting microorganisms. This killing or inhibiting action of a leaching antimicrobial is witnessed when an AATCC 147 test or other zone on inhibition test is run. These tests measure the zone of inhibition created by a leaching antimicrobial and clearly defines the area where the antimicrobial has come off the substrate and killed the microorganisms in the agar. This Figure shows the difference between the leaching and the non-leaching antimicrobial treatments on textiles both as first treated and then after five household launderings.

3.11 Benefits of Antimicrobial Textiles

An extensive variety of textile product is now accessible for the advantage of the consumer. Primarily, the main objective of the finish was to protect textiles from being affected by microbes particularly fungi. Uniforms, tents, defense textiles and technical textiles, such as, geotextiles have therefore all been finished using antimicrobial agents. Far ahead, the home textiles, such as, curtains 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.
Innovative know-hows in antimicrobial finishing are successfully employed in non-woven sector particularly in medical textiles. Textile fibers with built-in antimicrobial properties will also serve the purpose alone or in blends with other fibers. Bioactive fiber is a modified form of the finish, which includes chemotherapeutics in their structure, i.e., synthetic drugs of bactericidal and fungicidal qualities. These fibers are not only used in medicine and health prophylaxis applications but also for developed textile products of daily use and technical textiles.

3.12 Problems with Antimicrobial Finishes

Some common problems [15] related with the application of antimicrobial finishes are given as follows:

Stiff Hand and Fabric Strength Loss: This may be caused by the use of binders and resins with controlled-release finishes.
Color Change: this may be due to inappropriate choice of antimicrobial finishes.
Selectivity: Some antimicrobial finishes are efficient against Gram-positive bacteria or Gram-negative bacterial, while others against fungi. A formulation that is a mixture of several substances will be more effective for good all-round protection against microbes.
Toxicological and environmental problem: Include skin irritation, sensitizing, allergy or dermatitis on prolonged contact with skin, biodegradability and bioaccumulation.
Handling: the higher the biocide activity, the higher the need for safe handling and prevention from toxicity.
Development of resistant microbes: an area of concern regarding the use of antibacterial finishes is that their long term use may lead to the development of resistant microbes which might have deadly consequences for humans.

3.13 Considerations for Antimicrobial Textile Product Development

Antimicrobial finishing should not be considered as a simple add-on finishing process. Some of the important points that must be considered for the development of a textile product with antimicrobial properties are given as follows

- Identification and definition of the customer and the customer's needs.
- Selection of the most appropriate fabric.
- Selection of the most appropriate antimicrobial on the basis of safety considerations, regulatory compliance, application technology and efficacy.
- Selection of the most appropriate application technology.
- Setting up of a manageable testing and quality control program.

4. MATERIALS AND METHODS

4.1 Plant material extraction

Punica granatum L and *Punica granatum* are collected from the supplier. Fresh peel of *Punica granatum L* (Figure 2) were dried and made into fine powder. The collected quantities of *Punica granatum* fruits were shade dried and powdered. The methanolic and water extract of the powders were obtained. Ten gm of powder of each is soaked in methanol for twenty four hours to obtain ten percent concentrated solution, resulting in active substances being dissolved in methanol. The extract were filtered and used for antimicrobial finishing.

(a) **(b)**

Figure 2: Punica granatum (a) peel (b) powder

4.2 Microorganisms

After literature analysis, Bacterial cultures used in the present studies were obtained from Microbial Type Culture Collection [1] (MTCC) IMTECH. The bacterial strains Staphylococcus aureus (MTCC 737), Escherichia coli (MTCC 1687), Klebsiella pneumoniae (MTCC 6644), Proteus vulgaris (MTCC 742), Salmonella typhi (MTCC 733) were used.

4.3 Untreated Sample Criteria:

- Fabric Type : Double Lacoste
- Color : Verdigress
- Color Recipe :
  - Auxifix Yellow 4GL = 2.68%
  - Corazol Turkeys / Blue G =0.40%
  - Corazol Blue RS =0.33%
  - Salt / Soda =60 /15
- Required Dia : 65
- Finished Dia : 71
- GSM : 210
- Count : 24s
- Stitch Length : 2.60
- Shrinkage : - 8 to -9%
- Color Fastness : 4
- Rubbing : Dry – 4.5, Wet- 3.5

4.4 Preparation Sample

After collecting and screening of *Punica granatum* we separate the peel of it. And then take into dry zone so that we can collect dry peel. Then we grind that dry peel to change it to powder. Afterward we prepare (25*15) cm Sample for treating with antimicrobial finishing agent.

4.5 Application Method

When powder is ready to use, we followed the method from literature reviews [1], primarily we took the powder of *Punica granatum* peels of 2gm per liter. We prepared the solution according to 1:20 liquor ratio. Then we sunk the sample into solution & Run for 30 minutes at 500c. After running 30 minutes we separate the sample from the water.
Then we squeezed the sample & kept it for 24 hours at room temperature. Then we checked the sample by using Gromophenal for presence of microorganism. After that we applied various test like rubbing, color fastness to wash, shade variation, strengths test, agar diffusion & hand feeling.

4.6 Agar Diffusion Test

After the successful application, the treated and untreated fabric samples were placed in the AATCC bacteriostatic agar which has been previously inoculated (Mat culture) with a test organism. After incubation, a clear area of uninterrupted growth underneath and along the side of the test material indicates the antibacterial effectiveness of the fabric. The area of the inhibition zone is a measure of antibacterial effectiveness of the material.

4.7 Color Fastness to Wash Test

To measure the color fastness to wash under standard method, Fabric sample of size 6″x2″ was taken. Staple multi fiber test fabric along one edge of technical face of sample. Sample was set aside. 500 ml of water & 2 of detergent (1:20 Liquor ratio) were added to each canister. 25 steel balls were added into canister. Blank gasket was placed into canister. Sample was pressed into lid & lid was closed. Canister was clamped. Then rotor was started & run for 5 minutes at 600C to pre heat the canister & solution. Now the cover of one canister was unclamped. The samples were added to each canister in the row. After finishing the row was re-clamped again. Rotor was manually turned to the next row. The process was repeated until all samples were loaded. Then canisters were removed & each sample contents were added to separate beaker. Each sample were rinsed for 3 times & in 1 minute with de-ionized water, excess water was remove.

4.8 Color Fastness to Rubbing Test

To measure color fastness to rubbing of treated sample, we took two sample pieces of not less than 14x5 cm, one piece having the long direction parallel to the warp yarn & the other parallel to the weft yarns cut. These two pieces were used for dry rubbing test & two other similar pieces were cut & used for wet rubbing test. A Crock meter was used as the rubbing device. The untreated fabric was used as the control.

Wet test

After attaching the test sample into the testing instrument, the test piece was soaked in distilled water & squeezed so that it contained its own weight of water. The wet piece of the test piece was placed over the end of the finger of the testing device & rubbed it to & from in a straight line along a 10 cm long track on the dry test piece 10 times in the seconds with a downward force of 900g on the finger. The piece was dried at room temperature (Figure 3 (a)).

The second piece of the untreated fabric was treated in a similar manner. The degrees of the staining of the treated & untreated fabrics were evaluated with the help of geometric gray scales (staining) & the numerical ratings were assigned.

(a) (b)

Figure 3: (a) Wet Test (b) Dry Test

Dry test

Again test piece was taken & fixed to the rubbing device. A piece of the dry treated fabric was fixed in place over the end of the finger of the running device & rubbed to & from in a straight line along a 10 cm long track on the (dry) test piece ten times in 10 seconds with a downward force of 900g on finger. The second test piece (Figure 4 (b)) of untreated cloth was treated in a similar manner and then assessed under standard method and determined the result.

4.9 Wash Durability Test

The wash durability of antimicrobial activity of the dyed sample was evaluated after different wash cycles. The sample was washes with 5% neutral soap solution for 20 min. Washes sample was tested for the retention of antimicrobial activity after 2,4,6,8 & 10 laundering by AATCC-100 test method. After test procedures sample (Figure 4) was assessed and average all results.

Figure 4: Wash Durability test

4.10 Hand Feeling Test

After several test we tested hand feeling of treated fabric, at primary stage the sample was soft & Absorbent but after being treated the sample has been rough & harsh feeling than untreated sample. We tested that sample by using hand touch, now we saw the change after treated. Due to change of sample quality but we realized sample was not perfectly comfortable. Treated sample can be used.

5. RESULT & DISCUSSION

5.1 Color Fastness Properties to Wash Test

The color fastness properties of the cotton dyed with natural dyed from *P. granatum* was tasted according to ISO standard terms. According to the standard grey scale for color change & gray scale for color staining the results are observed & presented (See table 2). The color fastness property of *P. granatum* dyed fabric to washing was around 4-5. Thus results for color fastness for washing were ranging from good to excellent level. All results were present into following table-3, Average test result is 4.5

TABLE 2
Color fastness properties to washing

Sl. No	Color fastness to washing	Color fastness rating (dyed sample)
1	Changing in color	4
2	Staining on wool	4-5
3	Acrylic	4-5
4	Polyester	4-5
5	Nylon	4-5
6	Cotton	4-5
7	Acetate	4-5

1-Very poor, 2-Poor, 3-Moderate, 4-Good, 5-Excellent

5.2 Color Fastness Properties to Rubbing Test:

The color fastness properties of the cotton dyed with natural dyed were tested according to ISO standard terms. According to the standard grey scale for color change & grey scale for color staining the results are observed & presented (see table 3). The color fastness property of *P. granatum* dyed fabrics rubbing was around 4-5. Thus the results for rubbing were ranging from god to excellent Average test result for dry 4.5 & wet 4 shown in table-4 bellow.

TABLE 3
Color fastness properties to rubbing

Dry Rubbing	Wet Rubbing
4-5	4

1-Very poor, 2-Poor, 3-Moderate, 4-Good, 5-Excellent

5.3 Wash Durability Test for Antimicrobial Activities:

Wash durability test carried out with the test fabrics showed that the significant antimicrobial activities was actively retained in the fabrics treated with extract up to 5 washes even after repeated wash cycles. After 5 wash cycles the % bacterial reduction was very low & there was no activity found in the fabrics after 10 washes shown in bellow bar chart (Figure 5).

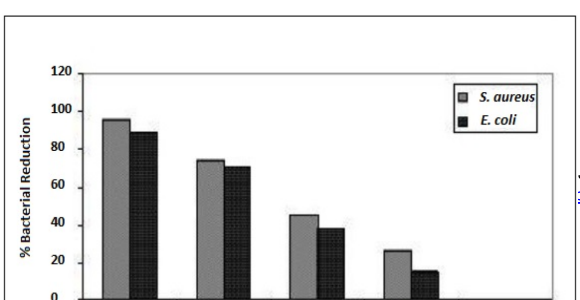

Figure 5: Bar chart of Wash Durability Test

The results of the wash durability test was similar to that who confirmed the wash durability of the fabrics treated with *P.granatum* extract alone retained the antimicrobial activity only up to 5 wash cycles, which gradually decreased & became nil after 10th washes.

5.4 Hand Feeling Test

Before treatment with antimicrobial finish the sample was soft & Absorbent but after being treated the sample has been rough & harsh feeling than untreated sample. We tested that sample by using hand touch by and experienced analyzer in laboratory standard atmosphere,

It can be seen that, the change after treated. Due to change of sample quality but we realized sample was not perfectly comfortable.

6. Conclusion

At present we can access many types of chemicals concerning as an antimicrobial finishing negotiator in local market. This is extensively used in numerous industrial units. As a result Microbial is being removed but physical composition of fabric is getting poor & it can be harmful for human skin. But if we use natural antimicrobial finishing agent of that purpose that will not be harmful for human skin, physical composition remains apparently normal that we noticed from previous test. Hence we got positive result for natural antimicrobial finishing chemical

So application of this natural chemical in lieu of local chemical is possible. That will be hygienic for environment & future of textile sector will be incredible.

7. REFERENCES

[1]. R.Rathinamoorthy1*, S.Udayakumar2 and G.Thilagavathi "Antibacterial efficacy analysis of *Punica granatum* L. leaf, rind and *Terminalia chebula* fruit extract treated cotton fabric against five most commonhuman pathogenic bacteria", international journal of pharmacy & life sciences- 2011

[2]. Raja ASM, Thilagavathi G, Kannaian T. (2010) Synthesis of spray dried polyvinyl pyrrolidone coated silver nanopowder and its application on wool and cotton for microbial resistance. Indian Journal of Fiber and Textile Research. 35: 59-64.

[3]. Sathianarayanan MP, Bhat NV, Kokate SS, Walunj VE. (2010) Antibacterial finish for cottonfabric from herbal products. Indian Journal of Fiber and Textile Research. 35: 50-8.

[4]. Thilagavathi G, Rajendrakumar K, Rajendran R. (2005) Development of antimicrobial textile finishes from plant species. Express Textile.

[5]. Gracious RR, Selvasubramanian S, Jayasundar S. (2001) Immunomodulatory activity of *Punica granatum* in rabbits: a preliminary study. J. Ethnopharmacol. 78: 85-7.

[6]. Kim ND, Mehta R, Yu W, Neman I, Livney T, Amichay A, Poirer D, Nicholls P, Kirby A, Jiang W, Mansel R, Ramachandran C, Rabi T, Kaplan B, Lansky E. (2002). Chemopreventive and adjuvant tharapeutic potential of pomegranate (*Punica granatum*) for human breast cancer. Breast Cancer Res. Tr. E. 71:203-17.

[7]. Murthy KN, Reddy VK, Veigas JM, Murthy UD. (2001). Study on wound healing activity of *Punica granatum* peel. J. Med. Food. *7*: 256-59.

[8]. Lamar AS, Fonseca G, Fuentes JL, Cozzi R, Cundari E, Fiore M, Ricordy R, Perticone P, Degrassi F, Salvia RD. (2008). Assessment of the genotoxic risk of *Punica granatum L* . (*Punicaceae*) whole fruit extracts. J. Ethnopharmacol. 115:416-22.

[9]. Fuentes VR, Exposito A. (1995). Las encuestas etnobotanicas sobre plantas medicinales en Cuba. Rev. Jard. Bot. Nacion. Univ. Habana. 16: 77-144.

[10]. *Jump up* ^ Madigan M, Martinko J (editors) (2006). Brock Biology of Microorganisms (13th ed.). Pearson Education. p. 1096. *ISBN 0-321-73551-X*.

[11]. *Jump up* ^ Rybicki EP (1990). "The classification of organisms at the edge of life, or problems with virus systematics". S Aft J Sci 86: 182–6. *ISSN 0038-2353*.

[12]. *Jump up* ^ LWOFF A (1956). "The concept of virus". J. Gen. Microbiol. 17 (2): 239–53. *doi*:10.1099/00221287-17-2-239. *PMID* 13481308.

[13]. http://www.microbeworld.org/what-is-a-microbe

[14]. http://www.columbia.edu/itc/hs/medical/pathophys/id/2009/antibioticsColor.pdf

[15]. http://indiantextilejournal.com/articles/FAdetails.asp?id=507

[16]. Calvo J1, Martínez-Martínez L, Antimicrobial mechanisms of action, US National Library of Medicine National Institutes of Health-2009

[17]. A.I. Wasif and S.K. Laga, use of nano silver as an antimicrobial agent for cotton, AUTEX Research Journal, Vol. 9, No1, March 2009

[18]. Antimicrobial Finishes by D.Gopalakrishnan & R K Aswini, Department of Textile Technology, PSG College of Technology, Coimbatore – 641 004

[19]. Yuan Gao and Robin Cranston, Recent Advances in Antimicrobial Treatments of Textiles, Textile Research Journal, 2008

[20]. 4. Gettings, R. L. and B.L. Triplett," A New Durable Antimicrobial Finish for Textiles". AATCC Book of Papers. 1978. Pg. 259-261.