‘‘Effect of Antimicrobial Finish of Woven Fabric in Garments”

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DEPARTMENT OF TEXTILE ENGINEERING

SONARGAON UNIVERSITY (SU), DHAKA.

THESIS TITLE: ‘‘Effect of Antimicrobial Finish of Woven Fabric in Garments”

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Submitted to the

DEPARTMENT OF TEXTILE ENGINEERING
SONARGAON UNIVERSITY (SU), DHAKA.

This report presented in partial fulfillment of the requirements for the degree of

BACHELOR OF SCIENCE IN TEXTILE ENGINEERING.

DEDICATION

To

Authors dedicate this report to our Family who give us chance to study in Textile Engineering and support us all time. Specially dedicate this report to our teachers and all the people who have helped us to complete this report.

DECLARATION

Authors hereby declare that, this project has been done by Authors under the supervision of **Md.Juel Sarker Lecturer**, Department of Textile Engineering, Faculty of Engineering, entitled with **"Effect of antimicrobial finish of woven fabric in garments."**

.Sonargaon University. Authors also declare that, neither this report nor any part of this has been submitted elsewhere for award of any degree.

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To

Md. Juel Sarker

Asst. Coordinator & Lecturer Department of

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(SU), Dhaka.

Subject: Letter regarding the submission the "**Effect of antimicrobial finish of woven fabric in garments**"

Dear Sir,

Authors are pleased to submit the Thesis the "Impact of Industrial Engineering in Woven Garments Production'' It was a great pleasure to work on such an important topic. This project was assigned to us in partial fulfillment of the requirement for the award of the degree of bachelor of Textile Engineering (4 years) from Sonargaon University (SU) Dhaka.

Authors believe that this project will certainly help you in evaluating our work. Authors would be very happy to provide any assistance in interpreting any part of the paper wherever necessary.

Sincerely Authors,

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FACULTY OF ENGINEERING
DEPARTMENT OF TEXTILE ENGINEERING

APPROVAL SHEET

This research entitled the "**Effect of antimicrobial finish of woven fabric in garments''** at Sonargaon University (SU), Dhaka. Summer 2021, prepared and submitted by **Md. Monir Hossain (Tex1703012114), Md. Rayen Ush Sayem (Tex1801013139), Md. Saiful islam Saif (Tex1801013018), Md. Suruj Ali (Tex1703012134)** in partial fulfillment of the requirement for the degree of Bachelor of Science in Textile Engineering has been examined and hereby recommended for approval and acceptance.

Md. Juel Sarker

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Then Specially Authors would like to show a huge thanks go to **Md. Juel Sarker, Asst. Coordinator & Lecturer,** Department of Textile Engineering, Sonargaon University (SU), Dhaka for her encouragement and valuable suggestions.

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ABSTRACT

This Thesis is the **"Effect of antimicrobial finish of woven fabric in garments"** Traditionally operated garment industries are confronting issues like Mask size different, low productivity, PPE fabric faults , high remake, modify, and rejection etc.

A cyclic-amine monomer, 3-allyl-5,5-dimethylhydantoin (ADMH), was grafted onto various textile materials in a continuous finishing process to prepare durable and regenerable antibacterial textiles. Highly efficient radical grafting polymerizations occurred inside or on the surfaces of fibers with the assistance of different initiators. In the finishing process, particular factors such as types and concentrations of radical initiators, drying, and curing conditions were rather important in effecting the final grafts of ADMH on fabrics and were studied carefully. After exposure to chlorine, the grafted hydantoin structures in the samples could be transformed into N-halamines, which provided powerful, durable, and regenerable antibacterial activities. The influence of hydrophilic/hydrophobic properties of the fabrics on the antibacterial activities was discussed.

Chapter: -1

Introduction

1.1 Background of the study

Antimicrobial finish is considered as the long-term procedure of penetrating each fiber of the fabric. Generally, this process is operated through a gentle heat process. This process finishes the germs and viruses from the fabric and keeps the good quality of the fabric. This report will discuss about the antimicrobial finishing of textile and the antimicrobial treatments for the textiles. **Covid-19** is now the most discussing topic of the world nowadays. This deadly **virus** is spreading day by day and the fatality rate of this virus is increasing. The world is now going through a very crucial time. Countries like Bangladesh are at high risk. The economy of Bangladesh is falling day by day. Garments industries are considered as the most important sector for Bangladesh. This also the biggest sector of Bangladesh from where the most revenue comes. This sector also considered as the principle source of foreign exchange earning of the country. The readymade garments (RMG) of Bangladesh are very much popular to many other countries of the world. Because of this **pandemic** this sector is facing many difficulties. Already the garments are losing orders and this is affecting the economy of Bangladesh very badly. This report will discuss about the present situation of the garments of Bangladesh. The report will also discuss about the antimicrobial approaches for textiles research and the Antimicrobial performance of cotton finished with triclosan, silver and chitosan. A review will be conduct in this report about the **gowns, masks** and **PPE** that are using in the healthcare. This report will also discuss about how the textile garments are fighting against this **deadly virus**. Hope that the author will get a clear knowledge about the mentioned sectors.

1.2 Objectives of the Study

Working on the mentioned sectors will help me to understand the overall measures taken by the organizations to ensure the proper safety of the employee of the organization. The objective of the study is to provide information about the present situation of the garments of Bangladesh and also discuss about the antimicrobial approaches for textiles research and the Antimicrobial performance of cotton finished with triclosan, silver and chitosan.

Specific Objectives:

Study was conducted with following objectives:

- To identify the importance of the antimicrobial approaches of the organizations and the antimicrobial treatment of those organizations.
- To identifying the measures, they have taken to fight with the deadly virus Covid-19.

Other Objectives

- To find out the problems faced by the garments.
- To recommend some suggestions based on findings.
- To observe the working environment of the garments.
- To understand the strategies that is taken by the garments.
- To understand the process, the garments, follow for antimicrobial approaches.

1.3 Origin of the Report

As a partial requirement of Textile program I need to go for internship report to gather practical experience and need to submit the report regarding that practical knowledge. This report is originated to require completing the Textile program from Sonargaon University. This report will definitely increase the knowledge of other students to know the factors as well as the methods of solving any arising problem.

In Soanrgaon University, Faculty of Science & Information Technology, Department of Textile Engineering, all students have to complete a three months’ internship in a particular organization as a part of completing graduation. At the end of the internship a report submission is mandatory, under the supervision of academic supervisor. I have I got an opportunity to do my internship over the mentioned sectors. I tried my best to provide the detailed information about the mentioned sectors. I provide some recommendation with my limited knowledge, which I believe will be helpful in future days.

For supporting my internship report I took help from the internet to make my internship report more efficient. I tried my best to collect all the information about the mentioned sectors.

1.4 Problem of the study

This study may raise some statement or remedy of the problem of some organization. Many organizations take some reasonable steps to fight with this pandemic. They are trying their best to aware people as well as the employees of their organization. All the processes and verification are done very cautiously so that no adverse situation occurs which may hinder.

Moreover, whenever they conduct their activities few new measures are taken or some new strategies are followed so that they can conduct the activities without any risk.

I got chance to work in various organization for some days which helped me to collect some sort of information about my report. The most important thing is, whole country is going through a tough time and every organization of the country is trying their best to maintain the safety in their organization. Many organizations have made a room at the entrance to sanitize the employees and also they are taking all the necessary measures to prevent this deadly virus. Organizations are awaking people to wear mask and maintaining social distance.

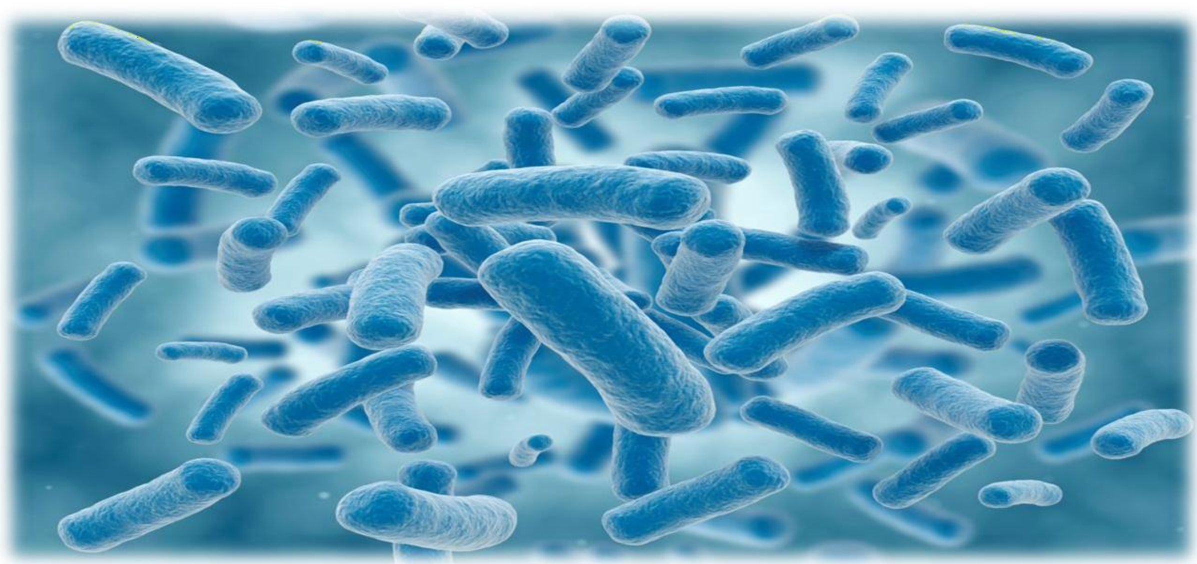
Chapter: 2

LITERATURE REVIEW

2.1Antimicrobial Finishing for Textile Sector

Antimicrobial finish is considered as the long-term procedure of penetrating each fiber of the fabric (Windler et al., 2018). Generally, this process is operated through a gentle heat process. This process finishes the germs and viruses from the fabric and keeps the good quality of the fabric. Antimicrobial finish is done for making hygienic garments (Gao and Cranston, 2017). For avoiding cross infection by pathogenic microorganisms. To control the infection by microbes. To safeguard the textile products from staining, discoloration and quality deterioration.

Generally microbial fabric refers to the textile that protects the fabric from the infection, viruses, germs, molds, mildew etc (Gupta, 2018). These fibers fought against the microbes and stop them from propagating. Microbial fabrics develop the quality of the fiber and maximize the comfort of the fabric and also extend the life of the fabric.



2.2 The Microbes or Microorganisms

Microbes are very little living thing which cannot be seen by the naked eye (Coman et al., 2019). They are included with the variety of microorganisms named Mold, Mildew, Fungi, virus etc. They can grow up rapidly under warm temperature and moisture. Further, sub divisions in the bacteria family are Gram positive (Staphylococcus aureus), Gram negative (E-Coli), spore bearing or non-spore bearing type. Among them some are very pathogenic and causes infections. Molds or mildew are the difficult organisms and the growth rates of these organisms are very slow (Lam and Yuen, 2017). They stain the fabric and deteriorate the performance properties of the fabrics. Fungi are active at a pH level of 6.5.

Foundation of the Microbes

Air

Soil

Human skin and body

All over

Perfect Circumstances for Microbial Escalation

Food

Warm temperature

Humidity

Open surface

2.3 Essentiality of Antimicrobial Finishes

Antimicrobial finishes are very much essential to complete the following objectives: \

For controlling the microorganisms.

To decrease smell from perspiration, mark and other soil on textile material.

To decrease the threat of infection from the fabric.

To stop the spread of the disease.

To control the worsening of the fabric made from nature.

Chapter: 3
Methodology

3.1Methodologies for Antimicrobial Finish

There are various methods for antimicrobial finishing which can be follow to develop the fabric.

The methods are given below:

Insolubilisation of the active substances in/on the fiber.

Treating the fiber with resin, condensates or cross linking agents.

Micro 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.

3.2Requirements for Antimicrobial Finish

The garments of Bangladesh are more susceptible for the deterioration of the fabric because the environment of the garments of Bangladesh is not so well maintained. Some private garments are aware of their environment but most of them are not cautious about the antimicrobial finish. So some measures are needed for the good antimicrobial finish of the fabric.

The requirements are given below:

Stability to washing, hot pressing and dry cleaning.

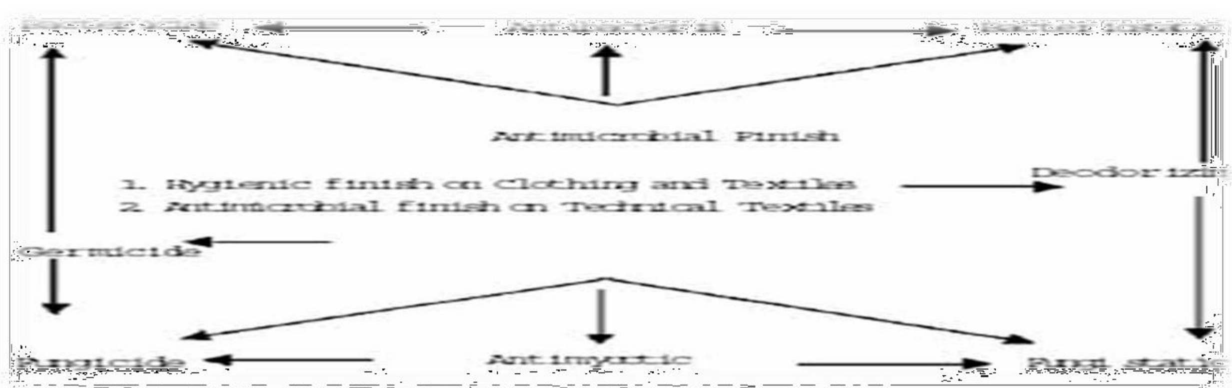
Careful actions to unwanted microorganisms.

Should be ca refuel about producing the harmful effects for the organization.

3.3 Mechanisms for Antimicrobial Activity

The antimicrobial activity refers to the method of killing the infection causes microbes (Gao et al., 2018). There are various antimicrobial agents which are applied for this purpose. The antimicrobial can be antibacterial, antifungal or antiviral (Gao et al., 2019). All the activities have different actions which are used to prevent the infection. They are given below:

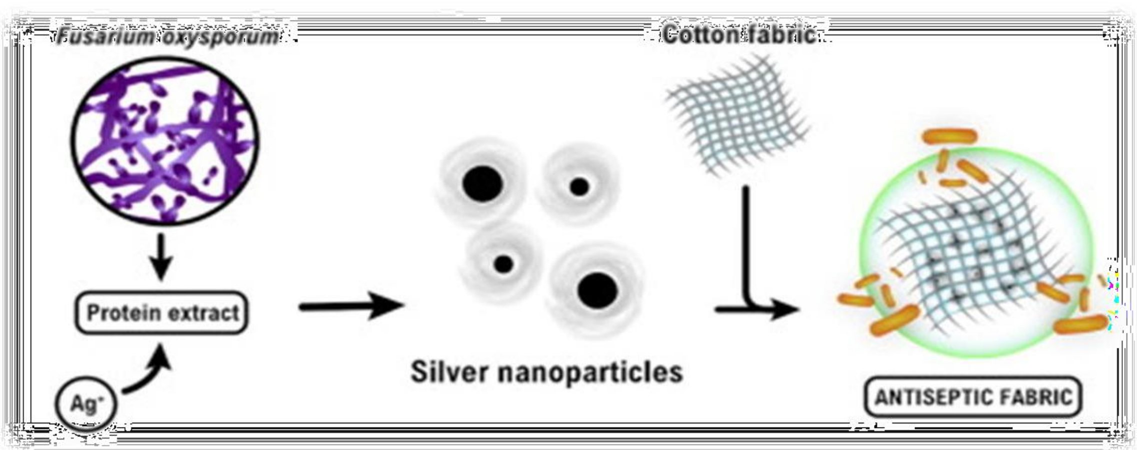
The activity, which affects the bacteria, is known as antibacterial and that of fungi is antimitotic (Dhiman and Chakraborty, 2018). The antimicrobial essence works in different ways. Leaching type of finish is very popular among them. In this method the microbes are poisoned and killed. This method is generally considered as very poor because this may cause several health problems. There is another method called bio-static finish. This method does not show any health problem and the durability of this method is good. A large number of textiles with antimicrobial finish function by diffusion type (Gao et al., 2019). This diffusion type has a direct effect on the antimicrobial finish. 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



3.4Antimicrobial Treatments for Textiles

Antimicrobial treatments refer to the activity of protecting the fabric from the microbes (Dhiman and Chakraborty, 2018). The microorganisms like mold and bacteria can grow up very quickly under warm temperature. They can be double in quantity in every 20 minutes. Fabrics exposed to moisture and sweat, such as home textiles and athletic apparel, are notoriously malodorous from these odor-causing microorganisms. The fabrics can be contaminated. Especially the fiber which is made by nature or man-made can be contaminated in many ways and the treatment of the fiber can be complete in various ways.

The antimicrobial activities can be introduced with the fiber at the time of spinning or extrusion (Morais et al., 2017). These additives can be combined with dyes or pigments or applied as a finishing process. Antimicrobial treatment is very much important for the fibers. Antimicrobial treatments develop the quality of the fiber and maximize the comfort of the fabric and also extend the life of the fabric.



3.5 The Process of Applying Antimicrobial treatment in Textile

The microorganisms like mold and bacteria can grow up very quickly under warm temperature (Shahid and Mohammad, 2018). They can be double in quantity in every 20 minutes. Fabrics exposed to moisture and sweat, such as home textiles and athletic apparel, are notoriously malodorous from these odor-causing microorganisms. The fabrics can be contaminated. Especially the fiber which is made by nature or man-made can be contaminated in many ways and the treatment of the fiber can be complete in various ways.

The treatment activities can be used during dyeing, pigments or in finishing process. One of them is given below:

Dyeing

Dyeing is the process of coloring the grey fabric with required dyes and chemicals (Yazdankhah et al., 2019). After knitting grey fabric is send to the dyeing section for dyeing. This process is also called the coloring of grey fabric.

Dyeing flow chart:

Grey fabric received from knitting

Batching

Dyeing

Squeezing

↓

Dryer

↓

Compaction

↓

Qc check

↓

Relaxation

↓

Qc pass goods

↓

Delivery

Different chemical used during dyeing:

Supradel NF liquid: wetting agent. Increase the wet ability.

Suprafluid C: anti creasing agent.

Supraquest 1009 liquid: sequestering agent.

Stabilizer S-150 liquid: increase the ability of peroxide.

Caustic: removed oil, wax from the fabric.

Acetic acid: used to neutralize the chemical.

Catazyme: increased the ability of Acetic acid.

After treatment:

Suprafluid C liquid: Anti creasing agent.

Suprableached NW liquid: leveling agent.

Supraquest 1009 liquid: removed the hardness of water.

3.6 The benefits of Antimicrobial Treatments

The benefits of antimicrobial treatments are very much important for the fabric. These keep the quality of the fabric and protect the fabric from getting contaminated. The benefits of antimicrobial treatments are given below:

In the healthcare industry, there are a variety of textiles that would benefit from the technology, including doctor's coats, bed linen and fabric covered chairs to name but a few.

Protect customer from skin problems causes by the microbes.

Provide the best textile to the customers by keeping the quality of the fabric.

Keeps the fabrics secure from the effect of the microbes specially fungi.

Will help shorten the timelines in bringing products with an antibacterial/antifungal/odor-reducing, antimicrobial feature to market.

3.7 Antimicrobial performance of cotton finished with triclosan, silver and chitosan

Triclosan and silver ions filter out or move away from the functional surface and work on leaching mechanism at a slow yet continued controlled rate to provide protection against microbes. Triclosan is a non-ionic agent; therefore, it is understood that it doesn't form chemical bonds with cellulose (Son and Sun, 2019). It has low molecular weight and acts like a disperse dye with high fatigue rate that diffuses into the fiber like polyester and nylon.

Over the last 30 years, this agent has become the most efficient and widely-used bisphenol, namely in many consumer and professional healthcare products, including soaps, lotions and creams, toothpastes, mouthwashes, underarm deodorants and also incorporated into textile fabrics and plastics. Triclosan is mainly used in association with polyester, nylon, polypropylene, cellulose acetate and acrylic fibers (Varesano et al., 2018). There are several products available on the market based on triclosan. Silver particles are incorporated in synthetic polymers before extrusion and during its use it diffuses onto the surface of the fiber where it forms silver ions in the presence of moisture and acts against microbes (Montazer and Afjeh, 2017). Release rate of silver from the fiber can be influenced by the physical and chemical characteristics of the fiber as well as the amount of silver in the fiber. N9 Pure silver is in non-ionized metallic state. It doesn't leach out from the fabric and acts against the microbes through contact with surface.

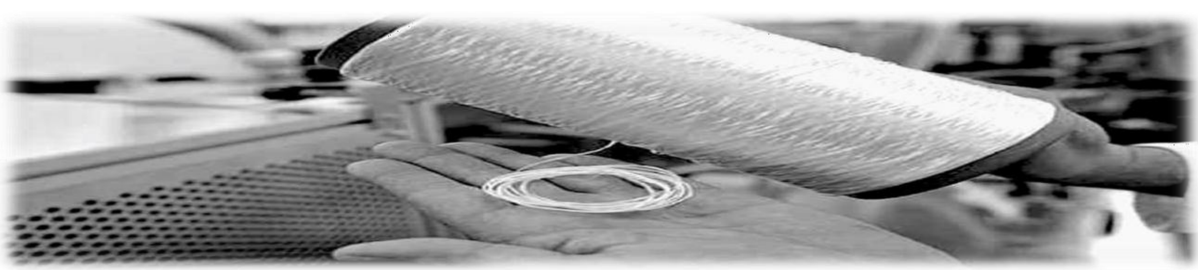
Triclosan and silver agents were evaluated for "Zone of inhibition" test which provided qualitative analysis of the extent to which antimicrobial agents effectively migrated onto the agar and diffused outward (Gouveia, 2017). The zone of inhibition for E. coli bacterium with both triclosan and silver based antimicrobial agents marked as C1 and C2 respectively. The same was done using S. aurous bacterium and results were same as for E. coli. It was found that Triclosan leached out to great extent and had more zone of inhibition whereas silver had a very low zone of inhibition due to inability of functional silver to diffuse through nutrient agar because it binds with proteins in the agar. This test wasn't done for chitosan as it forms bonds with cellulose and remains incapable to leach out.

The finished cotton fabrics were evaluated for antimicrobial activity against S. aureus and E. coli before and after each laundering cycle up to five times. The results for all three agents with two different application methods are presented. It was found that for triclosan and silver based finishes no substantial differences were noticed in antibacterial activity against both selected bacteria after curing. No significant difference was found among both application methods for triclosan and silver whereas the results for chitosan showed better activity after curing. There was 100 % reduction in antimicrobial activity in both the methods with triclosan (60 g/L) against both bacteria without laundering. It retained its antimicrobial activity up to 99.98 % even after 5th laundering cycle.

For further study, the concentration of triclosan was formulated from 5 g/L onwards. Silver at 10 g/L showed comparatively same reduction rates for both application methods against both bacteria. It showed 95.65 and 92.5 % reduction rates without any laundering and after five laundering showed 94.44 and 91.14 % reduction rates for S. aurous and E. coli respectively.

N9 pure silver based agent had only silver particles dispersed in water and it required no curing as it does not possess cross linking groups; concentration of it was selected from 3 g/L onwards.

Chitosan at 5 g/L showed comparatively poor activity against both bacteria. Loss in antimicrobial activity was obtained after first laundry cycle to a great extent (Montazer and Afjeh, 2017). The reduction rates were better i.e. 68.38 % as compared to 43.98 % for S. aurous and 51.39 % as compared to 37.74 % for E. coli with and without curing steps respectively. Up to 5th laundry the activity was reduced to 48.97 and 29.9 % for S. aurous and E. coli respectively even after curing. This could be due to removal of a superficial layer of chitosan from the fabric. Structure of chitosan resembles to that of cellulose and binds with cellulose through H-bonds and Vander Waal’s forces; curing could have resulted in formation of more bonds with cellulosic structure. Hence, for further finishing of cotton with chitosan and to see its durability on antimicrobial activity pad-dry-cure method was applied with curing at 150 °C for 5 min.



The antimicrobial efficiency of chitosan depends on its average molecular weight, degree of deacetylation and the ratio between protonated and unprotonated amino groups in the structure It is believed that chitosan of a low molecular weight is more antimicrobially active than chitosan oligomers (Gouveia, 2017). The efficiency also increases with increased deacetylation, which can exceed 90%. An important disadvantage of chitosan is its weak adhesion to cellulose fibers, resulting in a gradual leaching from the fiber surface with repetitive washing. To enable chitosan to bind strongly to cellulose fibers, various cross linking agents are used, including mostly polycarboxylicacids. In the presence of a cross linking agent, hydroxyl groups of chitosan and cellulose can form covalent bonds with carboxyl groups of polycarboxylic acid in an esterification reaction or with hydroxyl groups of imidazolidinone in an etherification reaction, thus leading to the formation of a crosslink between chitosan and cellulose. This greatly improves durability and wash resistance.

Antimicrobial Finishing Treatment with Antimicrobial Agents

As already referred, antimicrobial polymers can be prepared either by embedding an antimicrobial agent into the polymer bulk during their processing or by applying a surface coating or modification as a chemical or physical finishing treatment. Over the past decade, several surface grafting techniques have been studied; however, the method used strongly depends on if the textile fiber is natural or synthetic and also on its physic chemical features. Different techniques have been used to achieve textiles surface grafting, such as:

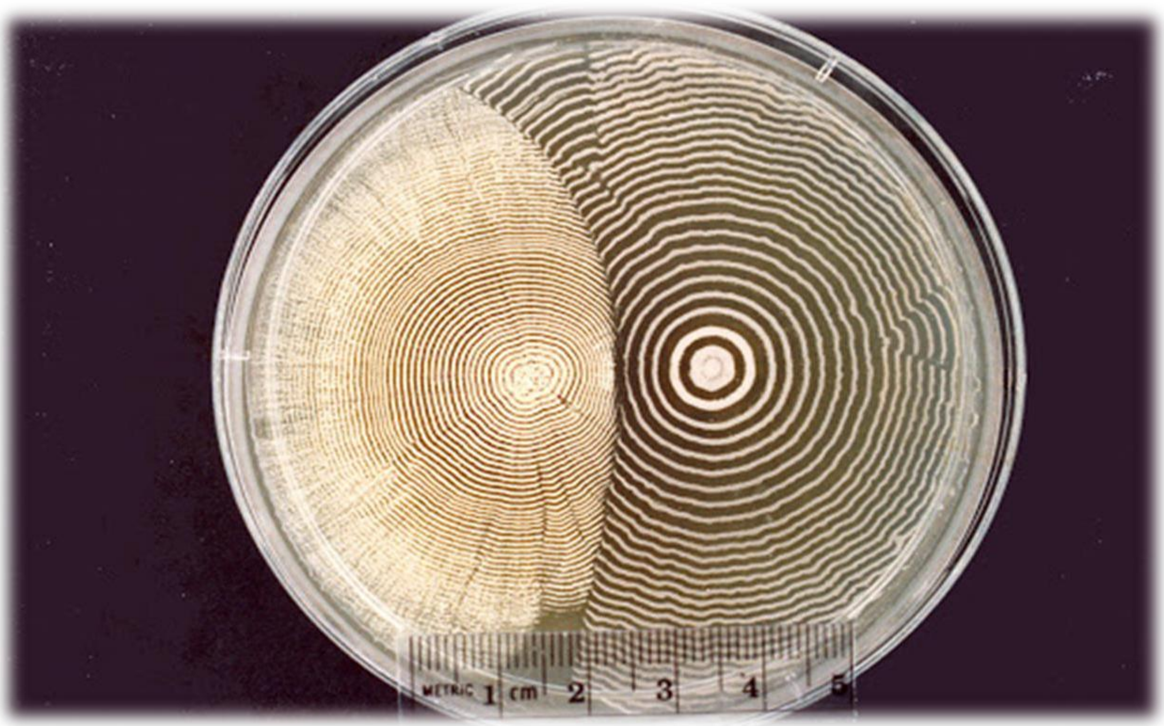
Chemical grafting;

Plasma-induced grafting using either radiofrequency or microwave plasma;
Radiation-induced grafting, which uses high-energy radiation.

Light-induced grafting using a source of ultraviolet radiation.

Regarding chemical grafting polymerization, conventional finishing techniques applied to textiles, such as dyeing, stain repellence, flame retardance or antibacterial treatments, and generally use wet chemical process steps. In wet chemical surface modification, the textile surface is treated with liquid reagents, which penetrate into the textile fabric in order to create reactive functional groups on the surface or to initiate copolymerization reactions with different antimicrobial monomers.Therefore, the surface fictionalization degree is not repeatable between polymers with different molecular weight and crystalline levels. This process may also lead to the generation of hazardous chemical wastes and can result in textile surface etching. As an alternative, plasma treatment provides a clean technology for polymers’ surface modification without affecting their bulk properties. The free radicals and electrons created in the plasma enable the surface activation by chemical bonds breaking to create reactive sites, functional groups or for later grafting of antimicrobial chemical moieties (Montazer and Afjeh, 2017). For instance, treated a cotton/PET blend fabric with a water-repellent treatment through activating the surface with plasma, depositing vaporized fluorocarbon-based monomers and then graft polymerizing the monomer with a second plasma exposure.

The fabrics were then further treated with an antimicrobial agent, namely a quaternary ammonium salt. Plasma treatment was used to induce free radical chain polymerization of the agent, resulting in a graft polymerized network on the fabric (Gao et al., 2018). It was shown that the water repellent treatment was efficient to obtain a high hydrophobic fabric with high durability to laundering. The results of the antimicrobial tests showed an activity reduction of both Gram-positive and Gram-negative bacteria by more than 99.994%, proving that the antimicrobial agent can act effectively on the water repellent-treated fabric. Moreover, cotton fabrics have been preprocessed with plasma in order to increase the surface roughness to allow the loading of higher concentrations of silver and zinc oxide, which are used as catalyst to promote the reaction between halogenated phoenix compounds with Microbes.



When using metals as the antimicrobial agent, the treatment of natural fibers can only be undertaken at the finishing stage, and various strategies have been studied to enhance the uptake and durability. Cotton, for instance, has been pre-treated with succinic acid anhydride, which acted as a ligand for metal ions (Ag + and Cu 2+) of metallic salts to provide very effective antibacterial activity (Montazer and Afjeh, 2017). Plasma pre-treatment has also been used to create active groups on synthetic and natural polymers' surface to be combined with TiO 2 and SiO 2 nanoparticles.

Moreover, some authors have proposed the association of the nanoparticles with a polymeric matrix, such as silver nanoparticles associated with polysiloxane, to improve the durability of the antimicrobial effect. The polymeric matrix on the fabric surface, with embedded nanoparticles, works as a controlled delivery system of ions, promoting the long-term antimicrobial activity, especially against laundering, as happens with the commercial product Silvadur.

3.8Antimicrobial Approaches for Textiles Research

World fiber consumption has increased over several decades; from 1950 to 2008, the per capita consumption increased from 3.7 kg to 10.4 kg, and through continuous development, it recorded in 2014 a demand of 55.2 million tons (122 billion pounds) of synthetic fibers, in addition to the natural fibers, including cotton and wool, which have a demand of 25.4 million tons. Fiber-based textile structures play an important role in several industries throughout the world, being used every day in order to meet different purposes (Gao et al., 2018). Obviously, the technological advances of textiles are mainly recognized in clothing products; however, they also play important roles in other industries, such as food packaging, domestic home furnishings, automotive textiles, air filters, water purification systems, thermal and mechanical protection, sport equipment, medical devices, healthcare and hygienic applications.

Therefore, as consumers are becoming increasingly aware of the implications on personal hygiene and the health risks associated with some microorganisms, the demand for antimicrobial textiles has presented a big increase over the last few years. In 2000, it was estimated that the production of antimicrobial textiles reached about 30,000 tones in Western Europe and 100,000 tones worldwide. Moreover, between 2001 and 2005, in Western Europe it was reported an annual production increase of antimicrobial textiles around 15%, being one of the fastest growing sectors of the textiles industry. In a recent issue of Performance Apparel Markets, the report “Antimicrobial fibers, fabrics and apparel: innovative weapons against infection” referred to the global market for antimicrobial agents being expected to increase by about 12% each year between 2013 and 2018.

In order to impart an antimicrobial ability to textiles, different approaches have been studied, which can be mainly divided into the inclusion of antimicrobial compounds in the polymeric fibers that can leach from the polymeric matrix, the grafting of certain moieties onto the polymer surface or the physical modification of the fibers' surface. Regarding the antimicrobial compounds, different types have been used, such as quaternary ammonium compounds, triclosan, metal salts, polybiguanides or even natural polymers. Any antimicrobial treatment performed on a textile needs to satisfy different requirements besides being efficient against microorganisms, but the main challenge is the concomitant requirement of non-toxicity to the consumer, namely cytotoxicity, allergy or irritation and sensitization (Varesano et al., 2018). Moreover, microorganisms in the presence of some antimicrobial agents may become resistant and the appearance of multi-drug-resistant bacteria is increasing at a worrying rate, being for the medical world one of the biggest challenges to face. Thus, the development of new and efficient antimicrobial treatments is still an important current topic of research, mostly regarding an alternative therapeutic strategy based on plant-derived antimicrobials. In order to control the generation of resistant bacteria, not only the effective prevention and control of infections is extremely important, but also monitoring the practice and application of antimicrobial agents.

Antimicrobial Treatments for Textiles

Antimicrobial treatments refer to the activity of protecting the fabric from the microbes (Gao et al., 2018). The microorganisms like mold and bacteria can grow up very quickly under warm temperature. They can be double in quantity in every 20 minutes. Fabrics exposed to moisture and sweat, such as home textiles and athletic apparel, are notoriously malodorous from these odor-causing microorganisms. The fabrics can be contaminated. Especially the fiber which is made by nature or man-made can be contaminated in many ways and the treatment of the fiber can be complete in various ways.

Some approaches are based on the use of specific antimicrobial agents, which in the case of synthetic fibers may be incorporated into the polymeric matrix. Another possibility, which can be used for synthetic and natural fibers or any textile fabric, is the application, in the finishing stage, of antimicrobial agents on the material surface. Depending on the approach used the antimicrobial textile may act by two different ways, by contact and/or diffusion. In the case of contact, the agent is placed on the fiber and does not disperse, so it will act just if the microorganism touches the textile surface. In the case of diffusion, the agent is on the fiber surface or in the polymeric matrix, and it will migrate from the textile to the external medium to attack the microorganisms

The Antimicrobial Agents

Most of the antimicrobial agents used in commercial textiles are biocides acting in different ways according to their chemical and structural nature and affinity level to certain target sites within microbial cells. Those different modes of action may be:

Damage or inhibition of cell wall synthesis, which is critical for the life and survival of bacterial species;

Inhibition of cell membrane function, which is an important barrier that regulates the intra- and extra-cellular flow of substances, could result in the leakage of vital solutes for the cells' survival;

Inhibition of protein synthesis, which is the basis of cell enzymes and structures, consequently leading to the death of the organism or the inhibition of its growth and multiplication;

Inhibition of nucleic acid synthesis (DNA and RNA) due to the binding of some antimicrobial agents to components involved in the process of DNA or RNA synthesis. This inhibition interferes with normal cellular processes, compromising microbes' multiplication and survival;

Inhibition of other metabolic processes, for instance the disruption of the folic acid pathway, which is essential for bacteria to produce precursors important for DNA synthesis.

Antimicrobial Agents (Nature-based)

Due to the emergence of the antibiotic resistance of pathogenic bacteria, antimicrobial compounds extracted from herbs and plants have also been extensively studied as an alternative therapeutic strategy to combat microbial growth in textiles. Several plant-based compounds with a wide activity spectrum against different fungal and bacterial pathogens have been identified, and are commercially available. The main advantage of using these natural compounds for antimicrobial purposes is that they do not exhibit the side effects often associated with synthetic chemicals (Gao et al., 2018). Until now, no reports of antimicrobial resistance to these natural chemicals have been published. Despite the lack of research about the mechanistic basis of their antimicrobial action, it is supposed that the microbial resistance is prevented probably by their multiple action mechanisms, avoiding the selection of resistant bacteria strains.

Moreover, these substances may present an efficient antimicrobial effect, with safety, easy availability, non-toxicity to skin and being environmentally-friendly. In addition to these compounds, natural defensive amino acids and peptides, which are found in every living organism, have also been considered as promising candidates for antimicrobial textile applications. Those antimicrobial peptides (AMPs) are a large number of small proteins that present a broad spectrum of antimicrobial activity against various microorganisms, including both Gram-positive and Gram-negative bacteria. Many different AMPs from various families have been discovered in non-vertebrates and vertebrates, and they are characterized by their small size (12–50 amino acids), the arginine and lysine residues responsible for their positive charge, and an amphipathic structure that interacts with microbial membranes. They are usually classified depending on their size, conformational structure or predominant amino acid structure.

Several studies have proposed different hypotheses describing the mechanism of AMPs' action, namely they may affect several internal cellular processes from macromolecular synthesis to the loss of ATP from actively-respiring cells. Many peptides are already used in medicine, such as daptomycin, pexiganan and psoriazyna. Besides that, there are many new antimicrobial peptides displaying interesting properties that are currently under development, such as plectasin NZ2114, which reveals potent bactericidal activity against Gram-positive pathogens. Another efficient AMP is l-cysteine, which has been successfully used to promote the bio functionalization of wool and polyamide, granting to those fibers a durable antimicrobial effect.

3.9 A Review of Isolation Gowns in Healthcare, Fabrics and PPE, Properties

The whole world is in panic. The global economy and education are being severely disrupted. The wheel of the economy is turning negatively. A frightening situation has been created in the minds of the people. Different countries have taken various steps. Meanwhile, the city of Wuhan in China and the Hong Kong Autonomous Region are going to succeed in their efforts to control the corona virus.

About 4 million workers work in the garment sector, the top export earner. Thousands of workers work in each factory, which is a dangerous environment for corona virus infection. The safe use of hand washing, sanitation, masks and sanitizers in most factories has not been fully ensured. As a result, workers are being forced to work with risk. There is no chance of delay to warn of impending danger.

The PPE fabric made in Bangladesh

To protect against the **corona virus**, protective clothing for the country's doctors, nurses and other staff is being made in Bangladesh. The **Personal Protective Equipment (PPE)** is being developed by Marks & Spencer (M&S) Country Director Swapna Bhowmick and a group of BUET alumni members. It consists of Sonar Bangla Foundation on behalf of Pay It Forward and Honest Team.

PPEs–that includes **mask, gloves, gown** and so on—are used different Fabric of different safety level. E.g.;

SMS Fabric for Biosafety Level -3 disposable gown

Taffeta 210 Fabric for Biosafety Level -2 Reusable gown

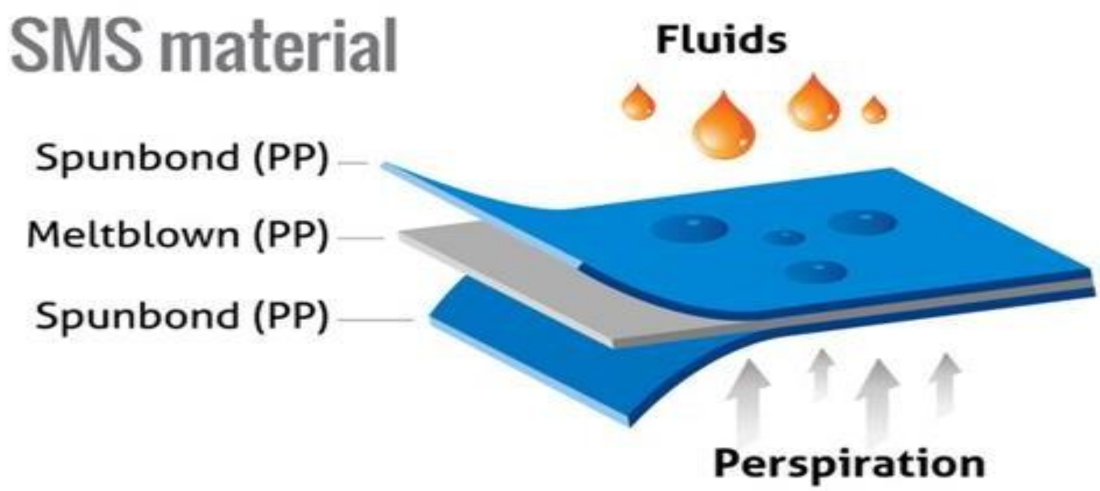
Knit and Woven Fabric (compact design & Chemical treated) for Level-1 isolation gown.

Amongst all of these the SMS fabric is much significant to ensure the safety level-3. Mainly the PPEs which are made for the medicals are made of by SMS fabric. The fabric that is used for regular purpose cannot ensure the safety level so SMS fabric is needed to ensure the highest safety level.

SMS Fabric

The full form of SMS is (Spunbond-Meltblown-Spunbond). Generally, this is the fabric which made by the polypropylene (Montazer and Afjeh, 2017). This is fabric is generally used in the medical to protect the doctors and patients from various viruses. The gowns, masks, gloves, shoe covers, medical caps etc. that are used in the healthcare are made by SMS fabric to ensure the highest protection. This fabric is consisting of various types of antimicrobial elements which protects the fiber from the attack of the germs and viruses.

Generally, this fabric has 3 layers the first layer is made of with spunbond polypropylene, the middle layer is the meltblown polypropylene and the bottom layer is the spunbond polypropylene.



Spun-bond

In 1940, the spunbond process was first patented and with further development has since become more and more popular across the world (Coman et al., 2019). The technique itself includes fibers being spun and then directly being dispersed into a web by deflectors or air streams. They are thermo bonded and do not use any chemicals. Every manufacturer liked this process because of its efficiency and the cost effectiveness.

This is used in making many types of household products such as baby diapers, adult diapers as well as medical products over the past twenty years. The use of spunbond is versatile. This also used in the medical sector, construction sector, agriculture sector etc.

It has many types of features also such as:

- The permeability of air of this is high.
- It has high strength.
- It has low weight.
- It has nice tear and wear properties.
- It can save one from the increased ultraviolet ray.

Meltblown

This process was arrived after the spunbond technology and it is also known as the process of producing micro-fibers at a lower cost. The technique includes hot air being blown onto molten thermoplastic resin that is extruded through a linear die containing hundreds of small holes, to form a fine fibered self-bonded nonwoven web (Montazer and Afjeh, 2017). This fiber is extremely thin and this is the main characteristic of this. This material is not only used for making antimicrobial fabrics the use of this material is versatile. This material also used in the filtration of air. Many types of electronic good are also made from this material.

3.10 How to protect Covid-19 for Textile Garmets

Bangladesh's export earnings are increasingly becoming dependent on the readymade garment (RMG) sector. Now this phenomenon is threatening our country's economy due to **corona-crisis**. The country's 84% remittance was gaining from this sector. The **Corona virus** epidemic poses a threat to the country's apparel sector, as foreign buyers have started revising their business strategies amid the prevailing critical situation. Bangladesh Garment Manufacturers and Exporters Association (BGMEA) said that more than one thousand RMG factories had received order cancellation or shipment delay notices from the buyers for export orders worth almost US$3 billion. It is affecting more than 1.44 million workers.

Now Bangladesh, USA, China, Italy, Spain, France and other European countries declared nationwide lockdowns as the countries took sweeping measures to reduce the spread of the corona virus. Following the lockdowns, major brands in Europe, including Primark and Indicted, shut their stores in the countries and asked Bangladeshi suppliers to hold shipment of ready garments for another two to four weeks.

Garments industries of Bangladesh are trying their best to fight with this **pandemic.** Some garments are open for producing the necessary equipments such as **masks, PPEs, gowns** etc. using in the healthcare. Bangladesh is making high quality **PPEs** and the BGMEA is thinking to exporting this **PPEs** because Bangladeshi garments are using high quality fabrics to made this instruments.

Amid this situation, global buyers are not only canceling and suspending orders but also, they are not taking ready goods. The current state makes us clear that the textile and RMG industry is vulnerable and dependent. The **corona-crisis** shows us that we should go to a self-reliant industry.

As the **corona virus** founded in China in December last year and has now spread to over 199 countries. Almost 2100 people have tested positive for the virus while five others have died in Bangladesh till 19 April. Based on the current situation almost all the factories including Epyllion, Dird Group, Apex Holdings, Concord, etc. have declared for closing their work from 26 March due to coronacrisis.

BGMEA President Rubana Huq said that everyone related to the RMG sector we have to be patient and not be afraid. Every manufacturer should contact their buyer and should try to convince them not to cancel their order fully and to take the ready goods through this employee can get their salaries. She also sent a letter to the global buyers urging them not to cancel or hold orders till July so that workers could get their wages and allowances during two Eid festivals. BGMEA has already given masks and also producing **personal protective equipment's (PPE)** for the protection against **corona-crisis**.

4.1 million peoples-oriented Bangladesh textile and apparel industry is passing a baleful time. As the **COVID-19** crisis escalates. The novel **corona virus** pandemic has led to worldwide store closures and now many brands are refusing to accept completed garment orders, which they would no doubt struggle to sell during the current global lockdowns. Till now over $3 billion orders has been cancelled from brands and buyers.

Bangladesh government has taken a great initiative for the garments industries. The Ministry of Finance revealed the guideline for the disbursement of the Taka 5,000 crore stimulus packages for the export-oriented industries. According to the guideline, an affected export-oriented apparel manufacturer can take a loan from the package at 2% interest to pay their workers' salaries for up to three months. But thewages of workers must be paid to either a bank or mobile financial service account, the guideline stated.

Furthermore the garments industries are also making high quality **PPEs** for the healthcare organizations as well as they are providing these medical equipments to the employees of the garments. They are strictly maintaining the social distancing. Some garments has declared that the employees of these garments will get their salary properly and if any of the employees get sick the garment will also ensure the treatment of that employee.

3.11 Data Collection Procedure: In order to make the report more meaningful and presentable, two sources of data and information have been used widely:

3.12 Primary Sources

Primary sources refer to the process of collecting data by an individual directly from the source (Rajendra et al., 2019). This is also called the firsthand evidence. Primary sources include historical and legal documents, eyewitness accounts, and results of experiments, statistical data, pieces of creative writing, audio and video recordings, speeches, and art objects.

I tried my best to get connected with some organizations so that I can gather information for my internship report but as the pandemic forced the country to shut down everything that's why I failed to get attached with the organizations. Although the whole country is in locked down situation some organizations were open for producing the **masks, PPE's** etc. So I physically visited those organizations to collect the information for completing my report.

The "Primary Sources" are as follows: -

nterviewing with the officials of those organizations.

Direct observation.

Data collection from employees.

Input the data in SPSS software.

In-depth study of selected cases.

3.13 Secondary Sources

This is the source of collecting data from the others. Generally, the common information about anything is collected through this source such as the annual report of a government organization (Saengkiettiyut et al., 2018). Internet is considered as the most common source among all the sources. Study related books and journals.

The "Secondary Sources" are as follows: -

The internet.

I have gathered the information from the national newspapers.

Get connected with the manager of some garments over telephone which helped me to collect the information.

Chapter 4

Dyeing Recipe & Finishing process

4.1 Recipe & Process

Antibacterial chemicals

Types	Chemicals
Inorganic chemicals and metal compounds	Silver zeolite, titan oxide, silver silicate, soluble glass powder with metallic ions, silver sulphonate, iron-phtalozyanat, copper sulphonate
Tenside	Organic silicon with tertiary ammonium salts
Phenol	Biozol, Thimol, Alkylenbisphenol sodium salt
Anilin	3,4,4-Trichlorocarbanilin
Natural products	Chitosan

Flow Chart of Dyeing Machine

Soaping

⇩

Drain

⇩

Hot Wash (80cx10) 1 Time

⇩

Cold Wash (40x10) 1 Time

⇩

Dosing – 0.5% RT (Sanitized T- 9919) -Ph = 4.5 – 5.0 – By acetic acid

⇩

RT x 5

⇩

Raise Temperature 60c

⇩

60cx30

⇩

Cooling to 40c Drain

⇩

Unload

Flow Chart of Stenter Machine

1st Time Dry Without Chemical 110c – 130 c

⇩

2nd Time RE/Stenter with Chemical

⇩

Hydroperm RPU - 20gm/l

⇩

SIM – 30gm/l

⇩

Speed – 30mm

⇩

Peader pressure - 2 Kg

⇩

Temperature – 120c

⇩

Over Feed - 40 %

⇩

Blower – 90/80

4.2 Effect of Antimicrobial Process on Fabric

Cotton fabrics were treated with two different crosslinking agents [butanetetracarboxylic acid (BTCA) and Arcofix NEC (low formaldehyde content)] in the presence of chitosan to provide the cotton fabrics a durable press finishing and antimicrobial properties by chemical linking of chitosan to the cellulose structure. Both type and concentration of finishing agent in the presence of chitosan as well as the treatment conditions significantly affected the performance properties and antimicrobial activity of treated cotton fabrics. The treated cotton fabrics showed broad-spectrum antimicrobial activity against gram-positive and gram-negative bacteria and fungi tested. Treatment of cotton fabrics with BTCA in the presence of chitosan strengthened the antimicrobial activity more than the fabrics treated with Arcofix NEC. The maximum antimicrobial activity was obtained when the cotton fabrics were treated with 0.5–0.75% chitosan of molecular weight 1.5–5 kDa, and cured at 160 °C for 2–3 min. Application of different metal ions to cotton fabrics treated with finishing agent and chitosan showed a negligible effect on the antimicrobial activity. Partial replacement of Arcofix NEC with BTCA enhanced antimicrobial activity of the treated fabrics in comparison with that of Arcofix NEC alone. Transmission electron microscopy showed that the exposure of bacteria and yeast to chitosan treated fabrics resulted in deformation and shrinkage of cell membranes. The site of chitosan action is probably the microbial membrane and subsequent death of the cell.

Environmental Effect

The durability of the antimicrobial treatment has a strong influence on the potential for release and subsequent environmental effects. In terms of environmental criteria, all compounds were rated similarly in effective removal in waste water treatment processes. The regular care of textiles consumes lots of resources (e.g. water, energy, chemicals) and antimicrobial treatments can play a role in reducing the frequency and/or intensity of laundering which can give potential for significant resource savings and associated impact on the environment.

4.3 Result & Discussion

Table summarized the extraction yield of each tested plant, which prepared by conventional or ultrasound method using water/ethanol. The extraction yield obtained by conventional method showed low percentage yield compared to those using ultrasound method. In ultrasound method, the yield of water extracts for all tested plants was much higher than ethanoic extracts. The water extract of roselle represented the highest yield among plant extracts followed by water extract of clove. Similarly, for ethanoic extract, the highest yield was achieved with of roselle extract followed by clove extract, while, the lowest extract yield was obtained with thyme. It has been reported previously that the water extract of different plants usually yields significantly higher amounts compared to ethanoic extracts of same plants. This may be due to using a high temperature for 30 min during extraction and also to the higher polarity of water. In addition, the utilization of vibrations to rupture plant cell walls, resulted in releasing of compounds and molecules into the solvent. In this method, the thermal treatment is not applied, which helps protect the functional particles and increasing the recovered materials from the sample. It is highly recommended to use ultrasound method for the extraction of compounds from various sources and for different uses.

The antimicrobial properties of ethanoic and aqueous extracts of roselle, clove, thyme, and rosemary at a concentration of 20% against BC, EC, SA, SE, VP, PA, and CA, have been assessed in this study. The results revealed that the ethanoic and water extract of selected plants are efficiently suppressing the growth of food pathogens and spoilage microorganisms with variable potency. As stated in and ethanoic extract of roselle had the maximum zone of inhibition against whereas water extract of roselle showed a maximum zone of inhibition against. The ethanoic extract of rosemary exhibited inhibitory effect against four of the pathogenic strains (EC, SE, BC, and SA) while aqueous extract of rosemary was effective against three strains only (EC, BC, and SA). In the antifungal analysis, just ethanoic extract of clove and thyme had valuable results against CA with inhi It has been reported previously that the extracts from several plants such as oregano, cumin, cinnamon, sage, and other spices possessed significant antibacterial and antifungal activities against wide range of food spoilage bacteria (Gram-positive and Gram-negative), as well as yeast and mold. The antibacterial activities of ethanol extract from five plants against *Listeria monocytogenes*, SA, and SE in raw pork by counting bacterial enumeration were investigated, and the results confirmed that fewest colonies of tested bacteria were observed with clove extract.

Chapter: 5

Conclusion

5.1 Conclusion

There is large difference between the theoretical knowledge and practical experiences. This is truer in case of study of Textile Technology. Theoretical knowledge gives us the concept about the topic we work for but the practical knowledge helps us to understand directly about the topic. So practical knowledge is better than theoretical knowledge. This has discussed about the trendiest topic of the world. The whole world is going through a tough time now. The Corona virus epidemic poses a threat to the country's apparel sector, as foreign buyers have started revising their business strategies amid the prevailing critical situation. This report has been discussed about the present situation of the garments of Bangladesh. A review has been conducted in this report about the gowns masks and PPE that are using in the healthcare. This report also discussed about how the textile garments are fighting against this deadly virus. Finally, it can be said that the main purpose of this report has become successful.

4.1 Reference

1. Shin, Y., Yoo, D.I. and Min, K., 2018. Antimicrobial finishing of polypropylene nonwoven fabric by treatment with chitosan oligomer. Journal of applied polymer science, 74(12), pp.2911- 2916.

2. Montazer, M. and Afjeh, M.G., 2017. Simultaneous x‐ linking and antimicrobial finishing of cotton fabric. Journal of Applied Polymer Science, 103(1), pp.178-185.

3. Heine, E., Knops, H.G., Schaefer, K., Vangeyte, P. and Moeller, M., 2017. Antimicrobial functionalisation of textile materials. In Multifunctional Barriers for Flexible Structure (pp. 23- 38). Springer, Berlin, Heidelberg.

4. Rajendra, R., Balakumar, C., Ahammed, H.A.M., Jayakumar, S., Vaideki, K. and Rajesh, E., 2019. Use of zinc oxide nano particles for production of antimicrobial textiles. International Journal of Engineering, Science and Technology, 2(1), pp.202-208.

5. Saengkiettiyut, K., Rattanawaleedirojn, P. and Sangsuk, S., 2018. A study on antimicrobial efficacy of nano silver containing textile. J. Nat. Sci. Special issue on nanotechnology, 7(1), pp.33-36.

6. Windler, L., Height, M. and Nowack, B., 2018. Comparative evaluation of antimicrobials for textile applications. Environment international, 53, pp.62-73.

7. Gao, Y. and Cranston, R., 2017. Recent advances in antimicrobial treatments of textiles. Textile research journal, 78(1), pp.60-72. Gupta, D., 2018. Antimicrobial treatments for textiles.

Coman, D., Oancea, S. and Vrinceanu, N., 2019. Biofunctionalization of textile materials by antimicrobial treatments: a critical overview. Romanian Biotechnological Letters, 15(1), pp.4913-4921.

8. Lam, Y.L., Kan, C.W. and Yuen, C.W.M., 2017. Developments in functional finishing of cotton fibres–wrinkle-resistant, flame-retardant and antimicrobial treatments. Textile Progress, 44(3-4), pp.175-249.

9. Gao, Y., Yu, X., Pierlot, A.P., Denning, R.J. and Cranston, R., 2018. A simultaneous antimicrobial and shrink resistance treatment of wool woven fabrics using the polymeric biocide polyhexamethylene biguanide. Journal of materials science, 46(9), pp.3020-3026.

10. Gao, Y. and Cranston, R., 2019. An effective antimicrobial treatment for wool using polyhexamethylene biguanide as the biocide, Part 1: Biocide uptake and antimicrobial activity. Journal of Applied Polymer Science, 117(5), pp.3075-3082.

11. Dhiman, G. and Chakraborty, J.N., 2018. Antimicrobial performance of cotton finished with triclosan, silver and chitosan. Fashion and Textiles, 2(1), p.13.

12. Morais, D.S., Guedes, R.M. and Lopes, M.A., 2017. Antimicrobial approaches for textiles: from research to market. Materials, 9(6), p.498.

13. Shahid, M. and Mohammad, F., 2018. Green Chemistry Approaches to Develop Antimicrobial Textiles Based on Sustainable Biopolymers A Review. Industrial & Engineering Chemistry Research, 52(15), pp.5245-5260.

14. Yazdankhah, S.P., Scheie, A.A., Høiby, E.A., Lunestad, B.T., Heir, E., Fotland, T.Ø., Naterstad, K. and Kruse, H., 2019. Triclosan and antimicrobial resistance in bacteria: an overview. Microbial drug resistance, 12(2), pp.83-90.

15. Son, Y.A. and Sun, G., 2019. Durable antimicrobial nylon 66 fabrics: Ionic interactions with quaternary ammonium salts. Journal of applied polymer science, 90(8), pp.2194-2199.

Varesano, A., Vineis, C., Aluigi, A. and Rombaldoni, F., 2018. Antimicrobial polymers for textile products. Science against microbial pathogens: communicating current research and technological advances, 3, pp.99-110.

16. Montazer, M. and Afjeh, M.G., 2017. Simultaneous x‐ linking and antimicrobial finishing of cotton fabric. Journal of Applied Polymer Science, 103(1), pp.178-185.

17. Gouveia, I.C., 2017. Nanobiotechnology: A new strategy to develop non-toxic antimicrobial textiles. de Current Research, Technology and Education Topics in Applied Microbiology and Microbial Biotechnology, A. Mendez-Vilas, Ed., Badajoz, Spain, Formatex Research Center, pp.407-414.