

A Review of Wool from Microbe's Growth

Rajneet Kaur¹ Dr. Archana Tomar²

^{1,2}Desh Bhagat University, Mandi Gobindgarh, Punjab, India

Abstract— Lifestyle of people has emerged to a long extent. This was reflected through the clothing attitude of people. Therefore, it has become a prime factor to manufacture textiles with antimicrobial activity. The present work is undertaken with a view to establish consciousness on hygiene and health safety, development of protective textiles like wool through antimicrobial finishing during dyeing. Because, microbe's growth during the wear of garments will have a negative impact on the wearer and the garment itself. The detrimental effects can be controlled by durable antimicrobial finishing of the textile using broad-spectrum biocides or by incorporating the biocide into synthetic fibers during extrusion. Henceforth, research were carried out on eco- friendly antimicrobial agents, based on natural products like silver, natural dyes, chitosan for textile application which is gaining worldwide interest now. Its major focus on new quality requirements that include maintaining the intrinsic functionality of the wool through an eco-friendly production process. Therefore, this paper reports a comprehensive review on natural product based bioactive agents such as silver, chitosan, natural dyes for antimicrobial finishing of wool and their evaluation. Also, purpose of microbial studies on wool, mechanism of silver, chitosan and nanoparticles antimicrobial action have been presented. The major challenges and the future potential of application of natural products on textiles have also been critically reviewed.

Key words: Antimicrobial Activity, Wool, Eco Friendly, Antimicrobial Mechanism

I. INTRODUCTION

Woollen fabric is highly popular to society because of their significant properties like light weight, heat conservation, does not wrinkle, resistant to dirt, affinity to skin and wear and tear. However wool is prone to attack by certain microorganisms, insects and fungi that cause functional, hygienic and aesthetic difficulties. Microbial infestation cannot be removed by even the most frequent washing until we wash at boiling temperatures usually which removes the aesthetic look of textile. Therefore extensive efforts have been made to prevent and safeguard textiles from infections caused by microorganisms and therefore huge demand prevails for antimicrobial finished woollen clothes which have capability to prevent microbes' attack, pungent odor when stored for longer periods [1].

II. NEED TO STUDY THE MICROBIAL PROPERTIES OF FABRIC LIKE WOOL

Because the skin may be in direct contact with wool/wool products, evidence of skin health and changes in this after such contact is of interest. There is a dearth of publications on skin health and its relationship with fabrics manufactured from either wool or other fibre types. One of the studies performed to understand the relation between skin and garment has been published. No other completed investigation of skin health related to fibre content of skin

coverings made from wool has been identified. Preliminary findings from an investigation on effects of wool fabrics against the skin of those predisposed to atopic dermatitis seem promising [2].

Bacterial populations were present on all fabrics for up to 28 days, with numbers remaining relatively stable in wool fabrics, and declining in polyester fabrics [3]. Treatments to confer antimicrobial properties on textiles have been developed and many reviewed [4]. One method applied to wool and wool products has been inclusion of silver [5] although concerns have been expressed about development of bacterial resistance to silver [6]. Effectiveness of other wool-metal complexes/salts has also been examined [7], as has chitosan as an antimicrobial treatment for woollen fabrics.

A. Silver as Antimicrobial Agent on Wool

A number of metals stated to have antimicrobial activity, among them silver ions showed the higher level of antimicrobial activity. Generally, the silver ions bind disulphide (S- S), and sulfhydryl (- SH) groups in the microbial cell wall's protein resulting in the disruption of metabolic processes, and ultimately in the cell death [8]. When silver molecules apply with binder or any cross-linking agent, an increased durability to clean wash was obtained in antimicrobial performance. It was through using an appropriate binder system with silver chloride or silver nm particles (AgNPs) [9]. Antimicrobial efficacy of Nano silver finish was known for variety of bacteria including *Staphylococcus aureus*, *Escherichia coli*, *Staphylococcus aureus* methicillin resistance strain (MRSA), and *Pseudomonas* [10].

B. Antimicrobial finished wool fabric

Guanidinylated chitosan treated wool fabrics show significantly improved antimicrobial characteristics [11]. Textile finishing using microwave heating has been reported by several authors and the result showed that microwave treatment can obtain clean, environmental friendly and highly efficient heating effect in textile finishing process [12]. Guanidinylated chitosan has good antimicrobial activity against *E.Coli* and *S.aureus*. Treatment of wool fabric with chitosan guanidine hydrochloride using conventional and microwave heating techniques has been studied. Scanning electron microscopy supports the adhesion of the chitosan guanidine hydrochloride on the surface of the wool under microwave heating.

C. Natural Dyes as Antimicrobial Agents

Dyes obtained from plants have antimicrobial properties. Like beet root, pomegranate seeds, curcumin etc. due to the presence of tannins quantity. Other sources like naphthoquinones such as lawsone from henna, juglone from walnut and lapachol from alkanet exhibit antimicrobial activity. Curcumin a common nontoxic natural dye used in fabrics and food has antimicrobial ability on wool. The

inhibition rates against *S.aureus* and *E.coli* were 45% and 30% respectively after 30 cycles of home laundering [13].

D. Auto Cleansing Agents of Wool:

Wool composed of natural proteins, is among the most prized, luxurious, delicate and widely used fabrics in the clothing industry. The wool gets cleaned self is due to Nano particle coating on it. Thus, wool fabrics were prepared with and without a nanoparticle coating, particles around five nanometres across (five billionths of a meter) composed of anatase titanium dioxide. The self-cleaning technology in this work uses titanium dioxide photo catalyst that, when triggered by light, it decomposes dirt, stains, and harmful microorganisms and so on. [14].

III. ASSESSMENT OF ANTIMICROBIAL ACTIVITY

To analyse the antimicrobial activity, the samples will be subjected to agar diffusion test. Then the organisms used in both the tests were *S.aureus* and *E.coli* as per ATCC. The evaluation of agar diffusion test was made on the basis of zone of inhibition of bacteria around the test sample. The percentage reduction (R) of bacteria by the specimen is calculated using the following formula:

$$R=100(B-A)/B$$

Where A is the number of bacteria recovered from the inoculated treated test specimen swatches in the jar incubated over the desired contact period, and B, the number of bacteria recovered from the inoculums treated test specimen swatches in the jar immediately after inoculation (at zero contact time)[15].

IV. CONCLUSION

With the increasing demand for fresh and hygienic textiles, the consumption of antimicrobials is increasing day by day. Research and development activity is trying to keep pace by developing more and more effective and safe solutions. There is increased interest in natural materials as probable sources, including those from animal (chitosan) and metals like silver. The field continues to be one of the most dynamic and one that needs to be kept a watch on for newer and innovative technologies. The demand for antimicrobial textiles will be spurred primarily by growing awareness on their importance in the minds of consumers.

ACKNOWLEDGEMENT

The authors are grateful to, Desh Bhagat University, for providing necessary facilities for carrying out this work.

REFERENCES

- [1] Yin Ling Lam, Chi Wai Kan, Chun Wah M.Yuen. Effect Of Metal Oxide On Anti-Microbial Finishing Of Cotton Fabric. *Bioresources*, 2012, 7(3), 3960-3983.
- [2] R.Laing, P.Swam,'Wool In Human Health And Well-Being' Natural Fibres: Advances in Science and Technology Towards Industrial Applications, RILEM Book series 12, 2016
- [3] McQueen, R. H., Laing, R. M., Brooks, H. J. L. and Niven, B. E. Odor intensity in apparel fabrics and the

- link with bacterial populations. *Textile Research Journal* 77 (7): 449-456.
- [4] Y. Gao, R. Cranston, R. Recent advances in antimicrobial treatments of textiles. *Textile Research Journal*, 2008, 78 (1): 60-72.
- [5] Li, W.-R., Xie, X.-B., Shi, Q.-S., Zeng, H.-Y., Ou-Yang, Y.S. and Chen, Y.-B. 2010. Antibacterial Activity and Mechanism Of Silver Nanoparticles On *Escherichia Coli*. *Applied Microbiology and Biotechnology* 85 (4): 1115-1122
- [6] Percival, S. L., Bowler, P. G. and Russell, D. 2005. Bacterial resistance to silver in wound care. *Journal of Hospital Infection* 60 (1): 1-7.
- [7] Freddi I., Arai, T., Colonna, G. M., Boschi, A. and Tsukada, M. 2001. Binding of metal cations to chemically modified wool and antimicrobial properties of the wool-metal complexes. *Journal of Applied Polymer Science* 82 (14): 3513-3519.
- [8] Nadia Silvestry-Rodriguez, Enue E. Sicairos- Ruelas, Charles P. Gerba, Kelly R. Bright, Title NA, *Rev. Environ Cotam Toxiol*, 191 (2007) 23- 45.
- [9] Tomsic, B.; Simoncid, B.; Orel, B.; Zerjav, M.; Shroer, H.; Simoncic, A.; Samardzija, Z. Antimicrobial activity of AgCl embedded in a silica matrix on cotton fabric. *Carbohydrate Polymers*, 75, 4 (2009) 618- 626.
- [10] Kanokwan Saenkittiyut, Pranee Rattanawaleedirojn, Supin Sangsuk, A study on antimicrobial efficacy of nanosilver containing textile, *CMU J. Nat. Sci. Special Issue on Nanotechnology*, 7, 1(2008) 34- 36
- [11] Zhao X, Quio ZZ, He JX (2010) *Journal of engineered fibres and fabrics* 5(3): 16.
- [12] Fouda MMG, El Shafei A, Sharaf S, Hebeish A (2009) *Carbohydrate polymer* 77(3): 651.
- [13] Han s and yang y, Antimicrobial Activity Of Wool Fabric Treated With Curcumin, *Dyes Pigm*, 64(2005) 157
- [14] Highfield, R. Feb 2008, this report can be available at: www.telegraph.co.uk.
- [15] Khan Mi, Ahmad A Khan, S A Yousuf M, Shahid M, Manzoor N, Mohammad F. Assessment Of Antimicrobial Activity Of Cateshu And Its Dyed Substrate, 2008, *J.Claen.Prod.*19,1385-1394.