

STUDY OF THE BACTERIA GROWTH ON CHOSEN TEXTILE MATERIALS

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Abstract

This paper is devoted to the study of relationship between chosen bacteria and chosen textile materials. This topic is nowadays very serious because of effect of pathogens in a time of reduced immunity is more important than in previous times. We are convinced that any antibacterial finishing treatments do not have efficiency for ever. We would like to discover which textile material has antibacterial effect and which does not have. Which structure of flat textiles support the growth of bacteria and which does not. For these purposes cloth from different yarns were prepared in three different simple structures such as plain, rib and twill weaves. Assessment of antibacterial activity was carried out as per the international standard test methods such as AATCC method and other American Standard methods [1-3]. Antibacterial activities were performed against test cultures. After careful analysis, their level of activity in relationship with chosen material, yarn structure and fabric weaves was observed. As an example tests on bamboo is described, because usage of bamboo is well known as a fiber with antibacterial properties [3]. The used method and examples are discussed below.

Keywords: bacteria cultures, antibacterial tests, bacteria growth on textiles, microorganism, chronic wounds.

INTRODUCTION

Microorganisms have become part of our daily lives. Various types of bacteria, fungi and viruses are present in the environment of our everyday life. Under suitable conditions, these microorganisms deposit themselves and multiply on our bodies and on the textile materials in contact with our skin. Microorganisms multiply rapidly in textiles in the presence of heat, humidity and food sources. Textiles being more vulnerable to microbial attack would cause many cross infections and allergic reactions. A number of textiles with antibacterial finishes are now in the market and their level of activity varies to a large extent.

It is needed to consider the properties of textiles than only their functionality in today's period. A modern man requires total comfort while wearing clothes and he is willing to pay more for this service. There are many allergies and other diseases among the people, that's why producers of clothing textiles look for ways how to enrich these textiles with further properties apart from aesthetic and functional properties. A suitable method could be use of

different raw materials, especially natural. For example bamboo was started to be processed, which is fast growing plant situated especially in the subtropical areas, where there is the most suitable conditions for growth. The aim of presented contribution is to evaluate this raw material in the point of view of growth of bacteria.

Three kinds of raw materials were chosen for the experiment – two normally used (cotton and linen) and one nontraditional (bamboo). From threads (CO, LI, VI) of the same fineness fabrics were made in different weaves and densities.

MATERIALS AND METHODS

Materials

For experiment fibers with concurrent characteristic were chosen. Natural raw material was chosen because of low allergic reaction and good tolerance to skin. This one concurrent characteristic is due to cellulose, which is content of all the chosen fibres (cotton, linen, viscose).

Cotton fibre (Fig.1a)) has characteristic reniform cross section. It is formed by fibrills, whose slanting slope in the primary screen makes rougher surface structure and its average middle length is 26 mm.

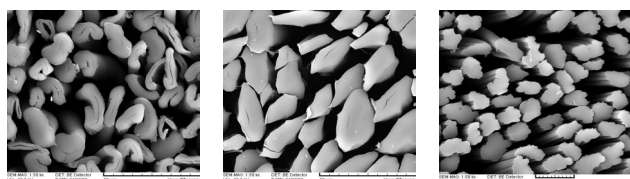


Fig. 1. Cross section of a) cotton, b) linen and c) viscose fibres

Linen technical fibre (Fig.1.b)) has characteristic knees and grooves along fibre formed by overlaying elementary fibres over themselves. Cross section of elementary fibres is triangular to hexagonal and its length is 15 - 20 mm.

For viscose, (Fig.1.c)) grooves along fibre are typical with irregular cross section with typical puffs. Its length can change, because viscose is made by wet spinning of regenerated cellulose. So it is a chemical fibre whose staple length is modified by cutting and tearing. These characters of fibre, predetermine the properties of textiles made of them and thuso their usage.

Structure of fabric

Samples of fabrics had common warp (fineness, density of cloth). In the weft were changed yarns made from cotton, linen and viscose fibre. All threads were made by ring-spinning technology, except cotton, where more rotor yarn was added to this classically made thread. Parameters of threads are:

Yarn fineness:

warp: cotton	T = 35,5 tex×2
weft: viscose	T = 29,5 tex×2
cotton – ring-spinning thread	T = 29,5 tex×2
cotton – rotor thread	T = 50 tex
linen	T = 58 tex

Parameters of fabric:

- warp density:	d = 12 yarns/cm
- weft density:	d = 10 yarns/cm
	d = 12 yarns/cm
- weave: plane	1/1
rib	2/2(I)
twill	1/3 Z

Fineness of yarns (especially weft) were chosen the most similar so that the results could be compared.

Chosen bacteria

As a chosen bacteria for testing: bacteria *Escherichia coli* (CCM 2024) and bacteria *Staphylococcus aureus* (CCM 299) were used. Both types of bacteria were chosen under standard ALE-G18 and ČSN I. The incubation was provided on the blood Columbia agar.

Methods

The samples were made by sample loom CCI that is in the weaving laboratory of Technical University of Liberec (TUL). The areal density of the cloth was constant. Thread density of the warp was determined by threading to weaver's reed, thread density of the weft was chosen from technical parameters of machine for weft insertion. The samples were wovem in two densities, there was a difference only of two wefts between samples.

For the antibacterial properties of textile material AATCC method was used (an Amarican Standard). The test was made in the laboratory of chemistry at TUL. Antibacterial activity was evaluated by both qualitative and quantitative test methods. The following are the descriptions of test methods employed for this study.

RESULTS AND DISCUSION

Specimens of test material are shown, including corresponding untreated controls of the same material placed in intimate contact with AATCC Bacteriostasis agar, which has been previously streaked with an innoculam of test organisms. Two test organisms namely *Staphylococcus aureus* and *Escherichia coli* were used for the study. After incubation, the growth of bacteria was counted and provided. AATCC Bacteriostasis agar medium was used as a growth medium for evaluation.

At first for the experiment bamboo fibres and yarns were used. We assumed that bamboo does not have antibacterial effect. The samples of bamboo fibres and yarns were sterilized 20 minutes under temperature of 90°C. On the sterilized samples bacteria were

used in concentration of 10^5 / ml in volume of 0,1 ml. Cultivation was made for 24 hours at temperature $36,5^{\circ}\text{C}$. After 24 hours the concentration of bacteria was lowered on 10^3 /ml from which 1 ml was used for next incubation with blood Columbia agar for 24 hours and under $36,5^{\circ}\text{C}$ temperature. After that the changes in sum of bacteria was counted and picture was taken (Figure 2 - 9).



Fig. 2. Viscose fibres – bamboo, bacteria – *Escherichia coli*.



Fig. 3. Growth of bacteria on bamboo fibres (viscose)

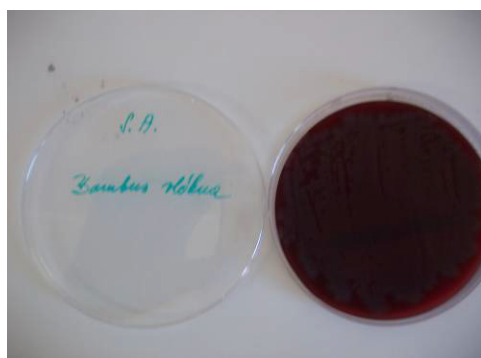


Fig. 4. Viscose fibres – bamboo, bacteria – *Staphylococcus aureus*.

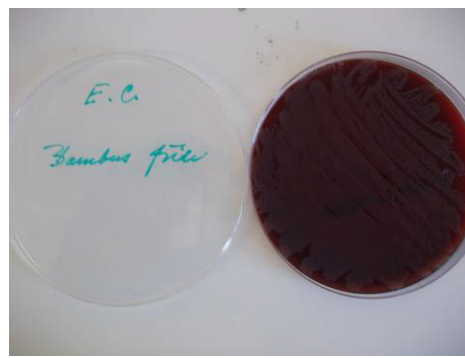


Fig. 6. Viscose yarns – bamboo, bacteria – *Escherichia coli*.



Fig. 7. Growth of bacteria on bamboo yarns (viscose).

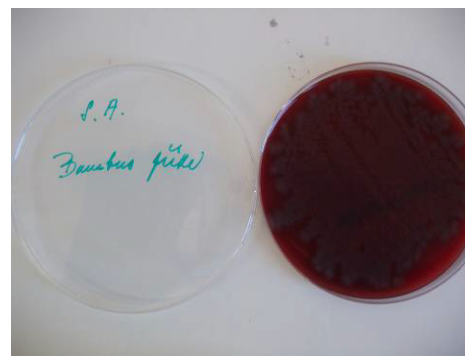


Fig. 8. Viscose yarns – bamboo, bacteria – *Staphylococcus aureus*.

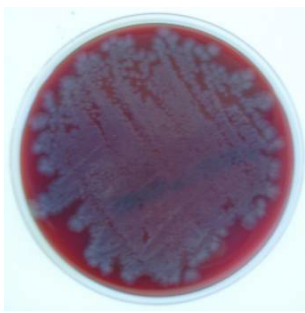


Fig. 9. Growth of bacteria on bamboo yarns (viscose).

CONCLUSION

Studies indicate that approximately 60% of people make an extra effort to buy antibacterial products. The number of textiles with antibacterial finishes has increased considerably over recent years. This development is accomplished by an increase in awareness of hygienic products on the one hand and increasing criticism of the use of chemicals on human on the other [5].

In the present study an attempt has been made to evaluate the antibacterial properties by standard recommended methods. Results of this test indicate that natural textile raw materials are not material with antibacterial efficiency.

All samples show growth of antibacterial properties of bamboo fibres (Figure 3 and 5) and bamboo yarns (Figure 7 and 9). In all cases were ascertained huge growth of bacteria (Figure 3, 5, 7 and 9). Since the active principles are based on natural principle and origin one can state that antibacterial

properties cannot be expected from the natural materials. However the research work has to be further carried out.

ACKNOWLEDGEMENTS

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