

THE In VITRO ANTIBACTERIAL PROPERTIES OF NON-MODIFIED WOOL

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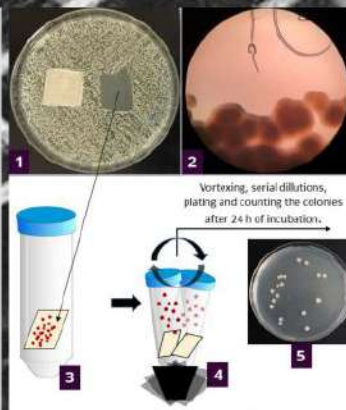
Abstract

Wool is considered to possibly exhibit antibacterial properties due to the ability of wool clothing to reduce the build up of odor, which arises from microbial activity of skin microbiota. Indeed when tested with standard method of agar diffusion plate (ISO 20645:2004), the untreated wool can be classified to show certain antibacterial effect due to the lack of growth under the specimen.

Therefore, we analysed in detail what happens to bacterial cells in contact with untreated wool placed on inoculated agar plates by counting viable cells attached to the specimens after 1 and 24 h of contact. We also analysed untreated cotton samples for comparison. All wool and several cotton samples showed no growth under the specimen but it was shown without a doubt that neither textile material kills bacteria or inhibits cell multiplication.

One non-modified wool and two cotton samples were tested for antibacterial efficacy toward several bacterial species by ISO 20645:2004 standard. After the incubation on agar plates (37°C/24 h) the growth under the specimen was determined visually (1) and under the microscope (2).

Further, the number of viable cells on the samples after 1h and 24h of contact with inoculated agar plates was determined. The textile specimen was transferred to 20 mL of sterile saline solution (3) and vortexed for five times 5 sec bursts (4) to detach the bacterial cells from the specimen. The supernatant was serially diluted up to 10⁷; plated and grown colonies were counted after the incubation at 37°C/24h (5). The number of bacteria was reported as log CFU cm⁻² of the specimen.



Results, numbers, graphs....

Conclusion

The wool showed antibacterial efficacy towards several bacterial species if interpreted according to agar diffusion test as "no growth" under the textile sample (ISO 20645:2004). On the other hand, experiments showed that neither raw wool sample as well as two different cotton samples exhibit any bactericidal activity in means of inactivating or killing bacterial cells, and that bacterial cells readily multiplied on the samples during 24 h.

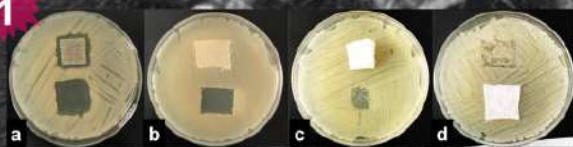
The explanation would thus be that bacteria strongly adsorb to wool while actively multiplying, developing a firmly attached biofilm. When wool sample was lifted, the bacterial biofilm remained attached to wool fibers removing the biomass from the surface of nutrient agar, resulting in clear "no growth" zone under the sample.

Since similar observations were in experiments with cotton, but not with compress gauze, it would seem that surface topography and structure of the textile plays an important role in antibacterial efficacy of the textiles unmodified with some antibacterial agent.

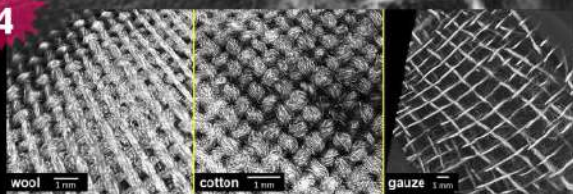
The results indicate that certain textiles, in our case wool, could exhibit antibacterial properties by removing excess bacteria that grew on the textile/skin interface when taken off the body.

Further tests with different non-modified textile materials, and same materials of differing structure, should completely resolve the question of why some textiles seem to show antibacterial efficacy without showing any bactericidal activity.

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1: Interpretation of the agar diffusion test results based on ISO 20645:2004 standard: inhibition zone and no growth under the Aquacell™ specimen (a) in the experiment with *A. baumannii*. No inhibition zone and no growth under the wool specimen (b) in the experiment with *B. cereus*. No inhibition zone and slight/moderate growth under the gauze specimen (c) in the experiment with *K. pneumoniae* and no inhibition zone and heavy growth under the cotton specimen (d) in the experiment with *S. aureus*.



2 and 3: Numbers of viable bacteria that were adsorbed onto different specimens after 1h (2) and 24 h (3) of contact in the agar diffusion test. Two experimental setups, one in which the inoculum concentration was low (log 5 = the concentration was ~ 10⁵ CFU ml⁻¹) and the other in which the inoculum concentration was high (log 8 = the concentration was ~ 10⁸ CFU ml⁻¹). w - statistically significantly different compared to wool; c - statistically significantly different compared to cotton; g - statistically significantly different compared to compressed gauze.

4: The 3D reconstruction of surface of textile specimens used in the experiments, obtained by X-Ray Microtomography.

