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Effect of high hydrostatic presser on staphylococcus aureus biofilm formed on stainless steel

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Introduction: Different bacterial species have natural ability to adhere to surfaces forming a biofilm. Biofilm formation is recognized as the main virulence factor in a variety of chronic infections representing a major problem in public healthcare. Staphylococcus aureus is the most frequent infecting bacteria of implants and prostheses, accounting for approximately 50-70% of infections. Stainless steel, although susceptible to bacterial attachment, is the most frequently used material for medical treatment and various types of equipment used in the medicine. Conventional disinfection and sterilization methods are often ineffective with biofilms, since microorganisms within the biofilm show different properties than those in free planktonic life. The use of high hydrostatic pressure (HHP) is a novel alternative strategy for controlling microbial biofilms. The aim of this work was to investigate the effects of HHP on biofilms formed by S. aureus on smooth or rough-surfaced stainless steel.

Methods: In this study S. aureus biofilms were grown on smooth or rough-surfaced stainless steel coupons in drip flow reactors. The bacterial biofilms were exposed to HHP in a continuous mode with 200, 400 or 600 MPa at room temperature for 10 min. Scanning electron microscopy (SEM) and fluorescence microscopy have been used to study bacterial biofilm structure. The logarithmic reduction factor (LRF) was used to determine the treatment effects.

Results: Biofilm forming S. aureus showed adhesion and multiplication on the surface of all steel coupons, even though heavier on rough-surfaced. Experiments with HHP demonstrated that at room temperature the S. aureus biofilm was inactivated over a pressure range of 200 to 600 MPa, with a 10 min treatment, especially on smooth stainless steel. The level of inactivation was different – a reduction from 1.6 to 1.2 to 0.9 LRFs was achieved in the slightly 200–400-600 MPa range on smooth stainless steel coupons. The reduction from 4.1 to 3.3 to 2.4 LRFs was achieved in the 200-400-600 MPa on rough-surfaced stainless steel coupons. Significant ($p<0.05$) inactivation was observed in biofilm formed on smooth stainless steel coupons as a result of pressure treatment in the 200 MPa. No significant differences in LRFs were detected between biofilm grown on rough-surfaced stainless steel, except for 600 MPa.

Discussion: HPP confirmed to have strong inactivation ability for S. aureus biofilms, especially on smooth stainless steel. These results indicate the potential of HPP as an alternative way for biofilm control in medical industry.

Biography

Gabriela Oledzka PhD, is an Associate Professor and Head of the Department of Medical Biology, Faculty of Health Sciences, Medical University of Warsaw. She received her PhD degree from the University of Gdansk in 2002 after the PhD studies at the Gdansk University of Technology and conducted her Postdoctoral work at The Lincoln University of Canterbury, The Animal and Food Sciences Division, New Zealand. Her main areas of interest are prevention of biomaterial-associated infections including biomaterials and biofilm community aspects; development of pathogenic biofilms on biomaterial surfaces and influences of physical and chemical agents on biofilm formation.

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