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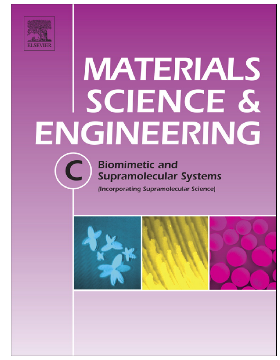

Anti-bacterial materials based on hyaluronic acid: Selection of research methodology and analysis of their anti-bacterial properties

Krystyna Guzińska, Dorota Kaźmierczak, Marzena Dymel, Ewelina Pabjańczyk-Wlazło, Maciej Boguń

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Anti-bacterial materials based on hyaluronic acid: selection of research methodology and analysis of their anti-bacterial properties

Krystyna Guzińska[1], Dorota Kaźmierczak[1], Marzena Dymel[1], Ewelina Pabjańczyk-Wlazło[2], Maciej Boguń[2*]

[1]*Institute of Biopolymers and Chemical Fibres, 19/27 M. Skłodowskiej-Curie Street, Lodz, Poland*
[2]*Lodz University of Technology, Department of Material and Commodity Sciences and Textile Metrology, 116 Żeromskiego Street, Lodz, Poland*

Corresponding author: maciej.bogun@p.lodz.pl

Abstract: In the frame of the presented research, highly-porous structures made of hyaluronic acid modified with bioactive compounds were prepared. The method of microbiological testing of hygroscopic materials has been elaborated by verification of the JIS L 1902:2002 and ASTM E2149-13a test methods. The research has shown that the method developed in accordance with ASTM E2149-13a is suitable for testing the activity of hyaluronic acid samples against bacteria. *E. coli* and *S. aureus*. In the case of *E. coli* it is preferred to use as a medium the phosphoric buffer and for *S. aureus* NaCl solution from NB. By analysing the results of the antibacterial properties, it is important to note that the introduction of a small amount of zinc and zinc oxide in the matrix from the hyaluronic acid (in the amount of 3% by weight of the polymer) makes it possible to obtain a material with a strong activity against the bacterial strains. It enables to use this type of material as a treatment for hard-to-treat, infected wounds. On the other hand, using a relatively small dose of the cephalosporin antibiotic did not result in high levels of activity against the bacteria Gram "+" and Gram "-".

Key words: hyaluronic acid, porous structures, anti-bacterial, methodology

1. INTRODUCTION

The material engineering field, indispensably, must take into account issues related to antibacterial and bactericidal properties in the design of new materials for advanced dressing systems and biomaterials.
Infected wounds are matters of primary concern not only for patients, however also for the medical personnel and healthcare systems in general [1]. If left untreated, the infection can spread to surrounding tissue and even the whole body, which can be life-threatening. In some cases - usually at a very extensive wounds, e.g. burns - it may develop potentially fatal sepsis and can lead to severe complications like abscess wounds, gas gangrene, tetanus or other diseases [2-4].
One of the stages of wound healing procedures is the appropriate choice of the dressing, which depends on the severity of the wound. The proper treatment is having a key role, as it accelerates the healing process and significantly improves the comfort of the patient [5]. In line with the achievements of science in this field the modern dressings differ significantly from those traditional ones. Its role is, in addition to providing a physical barrier against the ingress of pathogens and acting as protection against mechanical damage to the wound, to provide a suitable environment for accelerating the regeneration process [6]. This environment should be characterized by a sufficient degree of humidity and wound dressing should provide the gas exchange with the environment, alleviate pain in a patient by releasing analgesic agents or other auxiliary agents - drugs, growth factors, vitamins, minerals or amino acids, and even provide antibacterial or bacteriostatic conditions [7,8]. Polymeric foams are one of the newest and increasingly used in this regard groups of materials, due to the high sorption capacity and capability for controlled release of active substances (foam-like or sponge-like structures, sponges) [9]. The properties of foams depend on a number of characteristics and the polymer or its mixtures used. For example, absorption of liquids is affected by the foam pore structure (size and pore density), when the average pore diameter is larger, the foam may absorb more fluid. The pore system affects also the transport of active substances, gases and moisture on the outside or inside of the foam,