HIGHLY POROUS POLYMERIC MATERIALS FOR MEDICINE AND BIOTECHNOLOGY

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A highly porous materials based on biodegradable and biocompatible polymers in recent years has become particularly urgent owing to the development of modern reconstructive biomedical technologies: when restoring the structural integrity of the skin and soft tissues damaged by burns or other influences.

For this purpose use biodegradable porous polymer matrix. Porous materials act as a skeleton for the surface adhesion and cell growth, which should gradually replace evolving from these cells living tissues. In addition, the system of interconnected pores is required for mass transfer when using the material as a sorbent in detoxification of the body or of drug controlled release system.

There are a number of techniques to increase the specific surface of a polymer material, but not all of them are suitable for biopolymer materials.

The report discusses the three main methods of obtaining porous polymeric materials: a method of phase separation, electrospinning and the preparation of composite cryogels method. Phase separation method is considered on the example of the mixture of biodegradable polyurethanes: polylactides and polycaprolactone. Mixed solutions of polyesters in chloroform received composite film with different pore size and composition, as well as the repetition of nanofibers with antimicrobial and proteolytic activity. Highly porous biosorbent for selection of radionuclides produced by cryogelation of chitosan in the presence of cross-linking reagents.

BIOSAFETY ASSESSMENT OF POLYMER MATERIALS

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Creation and implementation of new medical polymer products influence on the progress of modern surgery significantly. But the question of biosafety is very actual issue for today. Questions about the ethical using of animals in contemporary medical and biological tests are increasingly attracting professionals and the public.

Within this work on evaluating the properties of biomedical hydrogels and experimental samples of microgels of different series, both native and degraded in sterilization processes at various ways and modes, mouse embryonal fibroblasts (STO) and multipotent mesenchymal stem cells (MMSC), extracted from bone marrow of cattle were used.

The obtained data indicate the ability of regenerative cells manifestation MMSC in the presence of experimental samples, as in the simulation burn and cut at modeling. In case of STO cell cultures regenerative ability is lower than in case of MMSC cells, but in case of simulation vitality burn exceeds the values obtained by simulation cut.

The study found out that the vitality of the cell cultures combined specimens hydrogels and microgels exceed the reference values. This can contribute to regenerative processes in the healing of wounds. Also degraded samples of the hydrogels and microgels based on recombinant spidroin non-toxic and biosafety.

SYNTHESIS OF POLYMERS WITH HIGH 3HHX CONTENT BY THE WILD-TYPE STRAIN CUPRIVIADUS EUROPUS B10646 AND STUDY OF THEIR PROPERTIES

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Polyhydroxalkanoates (PHAs), which are accumulated by numerous bacteria as carbon and energy storage materials under nutrient limitation and carbon excess, are aliphatic polyesters with thermoplasticity, optical activity and biodegradability. Properties of PHAs are determined by the PHA structure. Copolymers of 3-hydroxybutyrate (3HB) and 3-hydroxyhexanoate (3HHx) or 3-hydroxyhexanoate (3HHx) and 3-hydroxyvalerate (3HV) have been found to exhibit particularly useful material properties relative to other PHAs. However, synthesis of PHAs of a definite structure is a technological challenge; therefore, PHAs of a definite structure can only be produced based on the fundamental knowledge of their synthesis. Thus, this study addressed synthesis of copolymers of 3HB and 3HHx and 3HHx and 3HV by the bacterium Cupriavidus eutrophus B10646 and properties of the copolymers.

Bacterial cells were cultured under special conditions of carbonic nutrition (with such sources of carbon as fructose salts of organic acids with length of carbon chain C5-C6). To obtain P(3HB-co-3HHx) and P(3HB-co-3HV-co-3HHx) different concentrations of sodium valerate, sodium hexanoate and sodium acrylic (inhibitor of β-oxidation) fatty acids in the medium were used. Maximal content of 3HHx in P(3HB-co-3HHx) was 70 mol.% and maximal content...
MAGNETIC NANOPLATICLES CROSS-LINKED BY CHYMOTRYPSIN. NANOMECHANICAL CONTROL OF ENZYME ACTIVITY VIA LOW-FREQUENCY MAGNETIC FIELD

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Magnets nanoparticles can be used for nanomechanical control of biochemical properties of macromolecules via low-frequency non-heating magnetic field. In this concept, magnetic nanoparticles can convert energy of alternating magnetic field to changing conformation of immobilized macromolecules. If a macromolecule is fixed between two magnetic nanoparticles, it may undergo deformation such as stretching, compression and/or torsion. The deformation occurs due to Brownian relaxation of single domain magnetic nanoparticles. This means that the particle in a magnetic nanosuspension exposed to external magnetic field will be turning together with its magnetic moment vector.

It was shown previously that, in such conditions, super-low-frequency magnetic field (50Hz) reduces on 25% the rate of the reaction catalyzed by the enzyme (α-chymotrypsin), immobilized on copolymer-MNP aggregates [1]. The aim of this paper was to explore the effects provided by relaxation of magnetic nanoparticles on enzyme, immobilized on its surface. To do this, we studied the effect of radial force (80 μN) during 10 nsec applied to the chymotrypsin molecule by dynamic molecular modeling. This showed that in result of stretching catalytic center remains unchanged, while the binding site undergoes significant changes. Thus, such exposure should lead to changes only Michaelis constant. To confirm this, we have determined the α-chymotrypsin kinetic parameters change, immobilized on magnetic nanoparticles surface, under the influence of external magnetic field. As a result, we have established that the V_M is increase by 2.5 times, while V_M is not changed.

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INTERACTIONS BETWEEN NATURAL MINERAL NANO- AND MICROPARTICLES WITH BACTERIA

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The study is devoted of aspects of the interaction bacteria with particles of natural minerals (zeolitic tuff from some deposits in the Far East and Siberia, Russia) using size fractions 0.05-1, 1-10 and 10-50 μm. We took cultures of opportunistic pathogenic bacteria E. coli (25922) and S. aureus (209-P) to determine the microbiological activity of different-sized tuff particles (Vanchinskoye, Shvetruxskoye, Kuklovskoye, Lyutogskskoye) and deposits fields. We used standard methods and culture media: meat-peptone agar (MPA) and Endo agar. After preparing the solution (1 billion cells) according to the turbidity standard, zeolites were incubated together with bacteria for 1 hour. Different-sized tuff particles were added to the bacteria at concentrations of 10, 100, and 50 mg/ml. Then, using standard methods, we inoculated the suspension onto MPA and Endo agar and incubated it in a thermostat oven for 24 hours at a temperature of 37°C. The calculation of colony forming units was visual. The used zeolite particles were sterile (treatment in autoclave oven at 180°C for 3 hours).

It was shown that particles of 0.05-1 and 10-50 μm in size have virtually no effect on microorganisms. Whereas microparticles (1-10 μm) from different deposits have a significant effect depending on the type of a rock-forming mineral. Zeolite has a bacteriostatic effect, and mordenite – bacteriostimulating effect.

According to the data obtained, it must be concluded that the relationships between different-sized mineral particles and bacteria are often ambiguous and require further in-depth research.

The mechanisms of relationships between microorganisms and particles of mineral dust deserves focused attention, if only because every grain of atmospheric mist inhaled by us carries on its surface tens and hundreds of