The use of chloropropyltriethoxysilane in combination with biotemplates for the formation of functionalized organosilicon material

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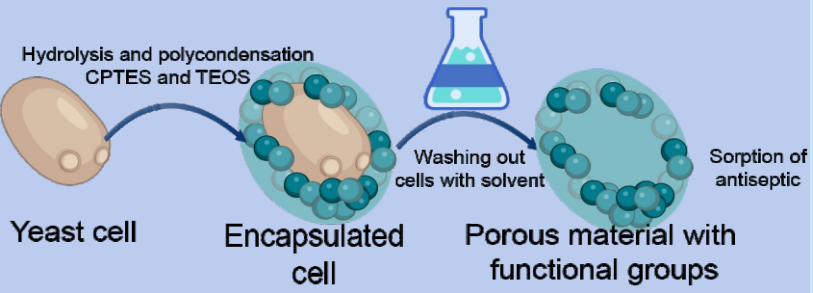
Introduction

One of the most significant global issues is the increasing resistance of microorganisms to antimicrobial agents. Microorganisms are the primary cause of infectious diseases and have a detrimental impact on the efficacy of traditional antimicrobial therapies. The conventional utilization of liquid antiseptics has resulted in adverse outcomes, including environmental contamination and the sustained proliferation of microbial resistance to active agents . In addition, many available antiseptics have lost their efficacy due to uncontrolled use during the SARS-CoV-19 pandemic. One promising solution to address these problems is the use of antibacterial surfaces that inhibit the growth of free microorganisms and within biofilms. In order to achieve effective loading of any active compounds, it is essential that the platform materials possess a porous surface. One of the methods for synthesizing a homogeneous porous matrix for the loading of pharmaceuticals and antiseptic agents is the utilization of template molecules, which are subsequently removed. Surfactants are used as templates, which determine the morphology and porosity of mesoporous silica nanoparticles. We have proposed a method of immobilizing yeast cells of *Ogataea polymorpha* VKM Y-2559 in an organosilicon material comprising a varying ratio of tetraethoxysilane and chloropropyltriethoxysilane. The catalytic activity of the microorganisms was evaluated to confirm their encapsulation, and the microorganisms were removed to obtain a porous functional material.

Formation of carrier material



It was determined that the *Ogataea polymorpha* VKM Y-2559 yeast strain can be used as a biotemplate and that the most suitable silane precursor composition for encapsulation is a CPTES/TEOS ratio of 95:5 (vol.%). The chloropropyl radical stays in the material after the cells are removed with N-methylpyrrolidone. The resulting material can serve as an intermediate platform for the further synthesis of a functionalized carrier for loading antiseptic or medicinal substances.

Results

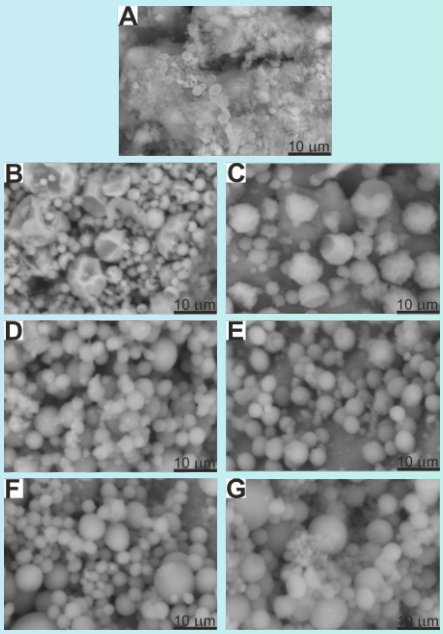


Figure 1. Scanning electron microscopy for polymeric organosilicon matrices with chloropropyltriethoxysilane (CPTES) volume content: a - 0%, b - 75%, c - 80%, d - 85%, e - 90%, f - 95%, g - 100%.

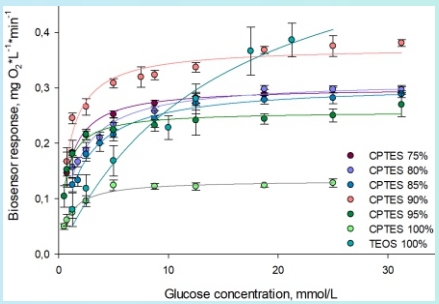


Figure 2. Calibration dependences of responses of biosensors using formed biohybrid materials on glucose concentration.

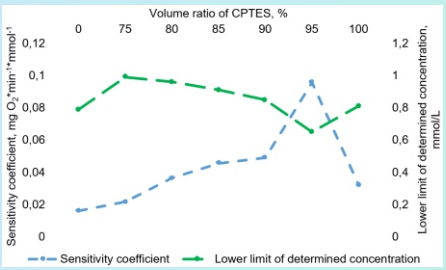


Figure 3. Dependences of sensitivity coefficients and values of lower limits of determined concentration on the composition of organosilicon matrices with immobilized yeast cells.

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