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Poly(3,4-ethylenedioxypyrrole) – biocompatible matrix for local drug delivery systems

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Introduction: In the past few years local drug delivery systems became very popular methods of treatment, making this process easier and more effective. Since conducting polymers are extensively studied in the field of biosensors, artificial scaffolds and neural probes, they are supposed to be promising materials for controlled drug delivery systems. Two most popular conducting polymers exhibiting biocompatibility are polypyrrole (PPy) and poly(3,4-ethylenedioxytiophene) (PEDOT). Recent literature reports indicate poly(3,4-ethylenedioxypyrrole) (PEDOP) as an ideal candidate as material for biomedical engineering, mainly because of its biocompatibility. PEDOP combines the most desirable properties of PPy and PEDOT: it has lower polymerization potential than PEDOT and, simultaneously, is more stable than PPy. In this study, we present one of the first efforts to utilize PEDOP for the immobilization of drugs. Two model drugs have been chosen – quercetin (Que) and ciprofloxacin (Cipro). Quercetin is one of flavonoid drug with wide spectrum of activities. Ciprofloxacin mainly treats bacterial infections caused by Gram-positive and Gram-negative bacteria.

Methods: Drug immobilization was performed via two methods – one step immobilization and three steps immobilization. In one step method, EDOP was electropolymerised in the presence of quercetin or ciprofloxacin. In three step method, drugs were immobilized as the result of the ion-exchange process on PEDOP matrix. Drug release process was performed by immersing polymer matrix in electrolyte solution (passive mode) or by the application of constant potential -0,7 V (active mode). The efficiency of controlled release of drugs was studied with UV-Vis spectroscopy. The morphology of PEDOP matrices was investigated by SEM.

Conclusions: Both methods of drug immobilization, one step and three steps, have been successfully applied to obtain drug-modified polymer matrices. Depending on the immobilization technique and model drug, there have been major differences in the dominant release modes. For PEDOP/Cipro films the dominant release modes is active release, while the passive release is dominant for PEDOP/Que films. SEM images show large variety of surface morphologies attainable by the proper choice of synthesis conditions.

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