proceedings

MDPI

Abstract

Development of an Electrochemical Aptasensor Based on Carbon Nanocomposites for the Sensitive Detection of Oxytetracycline †

Minas Kakos [1,2], Kiran Sudhakar Sontakke [2,*], Maria Pavai [3], Veronika Subjakova [2], Zsofia Keresztes [3], Leda Bousiakou [1], Ilia Ivanov [4], Mahendra Shirsat [5] and Tibor Hianik [2]

1 IMD Laboratories CO, El. Venizelou 29 & Perikleous 1, 12351 Athens, Greece; kakosminas@gmail.com (M.K.); leda@imdlaboratories.gr (L.B.)
2 Faculty of Mathematics, Physics and Informatics, Comenius University, Mlynská dolina F1, 842 48 Bratislava, Slovakia; subjakov@gmail.com (V.S.); tibor.hianik@fmph.uniba.sk (T.H.)
3 Research Centre for Natural Sciences, Magyar Tudósok Körútja 2, 1117 Budapest, Hungary; pavai.maria@ttk.hu (M.P.); keresztes.zsofia@ttk.hu (Z.K.)
4 Center for Nanophase Materials Sciences, Oak Ridge National Laboratory, Oak Ridge, TN 37831, USA; ivanovin@ornl.gov
5 RUSA–Centre for Advanced Sensor Technology, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad 431004, Maharashtra, India; mdshirsat@gmail.com
* Correspondence: kiransontakke07@gmail.com
† Presented at the 4th International Electronic Conference on Biosensors, 20–22 May 2024; Available online: https://sciforum.net/event/IECB2024.

Abstract: Massive use of antibiotics in veterinary medicine has led to their accumulation in meat and dairy products. Consumption of antibiotic-contaminated food can trigger the development of antibiotic-resistant bacteria, endangering human lives. Among antibiotics, the oxytetracycline (OTC) family of antibiotics is most widely used in veterinary medicine. Strict control of the antibiotics in food necessitates the development of fast and effective methods for OTC detection, for instance, in milk. One of the most promising approaches to OTC detection is based on the use of specially designed DNA aptamers. These DNA aptamers are relatively short, 15–60 bases, nucleotides folded in the solution in a 3D structure, forming a binding site for the target antibiotic. Aptamers can be chemically modified for attachment to sensor electrodes. In this work, we investigated the electrochemical detection of OTC using DNA aptamers specific to OTC that have been covalently immobilized onto the nanocomposite surface of a glassy carbon electrode with electrodeposited reduced graphene oxide and multiwalled carbon nanotubes. Differential pulse voltammetry, DPV, in the presentence of a ferri/ferrocyanide redox couple was used as an internal standard and to monitor the redox current. In the presence of OTC, the amplitude of DPV decreased, evidencing the blocking of charge transfer. After system optimization, we reached the limit of detection of 0.45 ng OTC/mL, which is 200 times lower than the maximum residue limit established by the European Commission of 100 ng OTC/mg.

Keywords: oxytetracycline; DNA aptamers; graphene oxide; multiwalled carbon nanotubes; electrochemical sensor

check for updates

Citation: Kakos, M.; Sontakke, K.S.; Pavai, M.; Subjakova, V.; Keresztes, Z.; Bousiakou, L.; Ivanov, I.; Shirsat, M.; Hianik, T. Development of an Electrochemical Aptasensor Based on Carbon Nanocomposites for the Sensitive Detection of Oxytetracycline. *Proceedings* **2024**, *104*, 22. https://doi.org/10.3390/proceedings2024104022

Academic Editor: Michael Thompson

Published: 28 May 2024

Copyright: © 2024 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

Author Contributions: Conceptualization, T.H.; methodology, T.H.; validation, M.K., K.S.S. and M.P.; formal analysis, M.K., M.P. and V.S.; investigation, M.K., K.S.S. and M.P.; resources, T.H.; data curation, T.H.; writing—original draft preparation, M.K., K.S.S., M.P. and T.H.; writing—review and editing, T.H., V.S., L.B., Z.K., M.S. and I.I.; supervision, T.H., M.S. and I.I.; project administration, T.H.; funding acquisition, T.H., L.B., I.I. and Z.K. All authors have read and agreed to the published version of the manuscript.

Funding: This work was funded under the European Union's Horizon 2020 research and innovation program through the Marie Skłodowska-Curie grant agreement No. 101007299 (T.H.), the Science Agency VEGA, project No. 1/0445/23 (T.H.). Part of the project was sponsored by the Center for

Nanophase Materials Sciences (CNMS), project No. CNMS2022-A-01196 (L.B. and I.I.), which is a US Department of Energy Office of Science User Facility at Oak Ridge National Laboratory.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.