LAB-CHIP EVALUATION OF BACTERIAL CELLS' DYNAMICS FOR RAPID ANTIMICROBIAL SUSCEPTIBILITY TESTING

Raluca-Elena Munteanu[1,2], Daniela Tudor[1,2], Sorin David[1], Eugen Gheorghiu[1,2], Mihaela Gheorghiu[1,2]
[1]International Centre Of Biodynamics, Bucharest, Romania;
[2]Faculty Of Biology, University Of Bucharest, Romania

e-mail: rmunteanu@biodyn.ro

Background: Availability of methods for the Rapid identification of microorganisms and for Rapid testing of antimicrobial susceptibility (AST) suitable for Point of need (PoN) analyses is an yet unmet need towards accelerated clinical diagnosis and treatment of infectious diseases, food and water safety control.
Aim: Develop multiplexed, high resolution (micro-spot) analyses and bacterial micro-chemostats with chromogenic media as a lab-chip approach for rapid, sensitive and specific quantitatitative assessment of microorganisms' dynamics, translatable in bench top and portable formats.
Method: Implementation of Optical-based electrical impedance spectroscopy assessment coupled with Differential Interference Contrast (DIC) and Reflected Light Microscopy assays for extensive characterization of the phenotypic features of single cells, including the cellular size, motion, morphology, membrane integrity and electrical parameters and enable discrimination of "persisters" from "resistant" cells upon antibiotic exposure.
Bacterial cells (gram negative *Escherichia coli*) are spotted on custom developed ITO chips, layered with agar strips and investigated in peptone medium with an inverted microscope in transmitted light (DIC) and in reflected light (red light - LED). The coupling with electrical actuation [1] is tested in conjunction with various electromagnetic field geometries for rapid, quantitative electro-optical, label-free multiparametric assessment.
Results and discussion: This novel bioanalytical platform allows real-time tracking of events taking place at the cellular level and evaluation of the division of individual bacterial cells as a reliable phenotypic feature for rapid AST and cell identification.
Conclusion: The multiplexed, high resolution (micro-spot) analyses allows establishing the set of representative cellular parameters that quickly (in couple of hours) reflect bactericidal, bacteriostatic effects towards real-time tracking of cellular effects of (novel) antimicrobial compounds.

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Keywords: bacteria, bioanalytical platform, electro-optic analyses

[1] Polonschii C., Gheorghiu M., David S., Gáspár S., Melinte S., Majeed H., Kandel M. E., Popescu G., Gheorghiu E. High-resolution impedance mapping using electrically activated quantitative phase imaging, *Light Sci Appl* 10, (**2021**) 20. doi.org/10.1038/s41377-020-00461-x