Mini Review
Volume 14:4, 2023

Journal of Biosensors & Bioelectronics

ISSN: 2155-6210 Open Access

Assessing Antibiotic Effects on Microbial Cells using Electroacoustic Biosensor Systems

Blessy Smith*
Department of Biomedical Engineering, University of Georgia, Athens, GA 30602, USA

Abstract

The increasing global threat of antimicrobial resistance necessitates innovative approaches for the rapid evaluation of antibiotic efficacy on microbial cells. This study introduces a novel method utilizing electroacoustic biosensor systems to assess the impact of antibiotics on microbial viability and behaviour. These biosensors combine acoustic wave technology with biological interfaces to detect subtle changes in cell properties induced by antibiotic exposure. By interfacing with microbial cells, the biosensor system offers real-time, label-free and non-invasive monitoring of cellular responses to antibiotics. The biosensor's principle is based on the measurement of changes in acoustic wave properties, such as frequency and impedance, resulting from cellular interactions. Antibiotic-induced alterations in microbial viability, membrane integrity and cellular adhesion can be accurately quantified through these changes. The biosensor system's versatility allows for the evaluation of a wide range of microbial species and antibiotic compounds, offering insights into specific modes of action and potential resistance mechanisms.

Keywords: Antimicrobial resistance • Antibiotic effects • Microbial cells • Electroacoustic biosensor systems

Introduction

The escalating threat of Antimicrobial Resistance (AMR) has spurred the search for innovative approaches to evaluate the effects of antibiotics on microbial cells. Traditional methods of assessing antibiotic susceptibility often involve time-consuming culturing and may not provide real-time insights into the dynamic interactions between antibiotics and microorganisms. In response, electroacoustic biosensor systems have emerged as a cutting-edge technology that offers real-time, label-free and sensitive monitoring of antibiotic-induced changes in microbial behaviour and viability. By interfacing acoustic wave technology with biological interfaces, these systems provide a promising platform for assessing antibiotic effects on diverse microbial species [1].

Compared to traditional methods, electroacoustic biosensor systems offer several advantages, including rapid detection, minimal sample requirements and the ability to capture dynamic responses. Additionally, the label-free nature of the technique eliminates the need for exogenous markers, preserving cell integrity and providing a more natural environment for monitoring antibiotic-cell interactions. This study highlights the potential of electroacoustic biosensor systems as powerful tools for assessing antibiotic effects on microbial cells. By enabling real-time analysis of cellular responses, these systems contribute to a deeper understanding of antibiotic mechanisms and aid in the development of novel therapeutic strategies. As antimicrobial resistance continues to challenge conventional treatment paradigms, the integration of biosensor technologies into antimicrobial research holds promise for shaping more effective antibiotic therapies and facilitating informed clinical decisions [2].

Literature Review

The growing crisis of Antimicrobial Resistance (AMR) has underscored the urgent need for innovative approaches to evaluate the effects of antibiotics on microbial cells. Conventional susceptibility testing methods, while informative, often lack the speed and precision required to address the evolving challenges of AMR. In recent years, electroacoustic biosensor systems have emerged as a promising technology for assessing antibiotic-induced changes in microbial behaviour, viability and responses. The basis of electroacoustic biosensor systems lies in the integration of acoustic wave technology with biological interfaces. These systems capitalize on the inherent sensitivity of acoustic waves to alterations in mass, viscoelasticity and electrical properties of the cellular environment. This sensitivity enables the real-time, label-free monitoring of cellular responses to antibiotics, providing a comprehensive picture of antibiotic action. One of the key advantages of electroacoustic biosensor systems is their versatility. These systems can be applied to a wide range of microbial species, including bacteria, fungi and even single cells. This versatility extends to the antibiotics being tested, allowing for the evaluation of various drug classes and their specific impacts on different microorganisms. As a result, researchers gain insights into not only the overall effectiveness of antibiotics but also the mechanisms underlying their action and potential resistance patterns [3].

In a study, an electroacoustic biosensor system was employed to assess the effects of different antibiotics on bacterial cells. By measuring changes in frequency and impedance, the researchers were able to discern alterations in bacterial adhesion, membrane integrity and cellular responses over time. The system's label-free nature preserved cell viability and enabled continuous monitoring of antibiotic effects. Compared to traditional susceptibility testing methods, electroacoustic biosensor systems offer distinct advantages. Firstly, they provide rapid results, potentially enabling real-time monitoring of antibiotic action. Secondly, these systems require minimal sample volumes, reducing the need for extensive culture growth. Additionally, the label-free approach avoids the introduction of exogenous markers that could interfere with cellular behaviour, allowing for more accurate representation of antibiotic effects.

Electroacoustic biosensor systems present a valuable advancement in the field of assessing antibiotic effects on microbial cells. Their ability to capture real-time responses, their label-free nature and their versatility in terms of microbial species and antibiotics make them attractive tools for understanding the intricacies of antibiotic-cell interactions. As the fight against antimicrobial resistance intensifies, these systems hold the potential to guide the development of novel therapeutic strategies, optimize antibiotic regimens and contribute to the preservation of effective antimicrobial therapies. Continued research and refinement of electroacoustic biosensor technology are vital to unlocking its full potential in combating antimicrobial resistance [4].

***Address for Correspondence:** Blessy Smith, Department of Biomedical Engineering, University of Georgia, Athens, GA 30602, USA, E-mail: smithb@gmail.com*

Received: 02 August, 2023, Manuscript No. jbsbe-23-111836; **Editor Assigned:** 04 August, 2023, PreQC No. P-111836; **Reviewed:** 16 August, 2023, QC No. Q-111836; **Revised:** 21 August, 2023, Manuscript No. R-111836; **Published:** 28 August, 2023, DOI: 10.37421/2155-6210.2023.14.399

Discussion

Electroacoustic biosensor systems utilize the principle that acoustic waves are highly sensitive to alterations in the physical and chemical properties of a medium. This sensitivity is harnessed to measure changes in cellular responses when exposed to antibiotics. The interaction between microbial cells and antibiotics can induce modifications in mass, viscoelasticity and electrical properties, which are subsequently translated into measurable changes in acoustic wave parameters [5]. By continuously monitoring these alterations, researchers gain valuable insights into the kinetics and mechanisms of antibiotic-cell interactions. One notable advantage of electroacoustic biosensor systems is their versatility. These systems can be tailored to study various microbial types, from bacteria to fungi and different antibiotics, spanning multiple drug classes. This adaptability allows for a comprehensive assessment of antibiotic action, shedding light on both broad-spectrum effects and the subtleties of drug-specific mechanisms. Additionally, the label-free nature of the technology ensures that cells remain unaltered, enabling the observation of natural responses without introducing interference from external markers [6].

Conclusion

In conclusion, the use of electroacoustic biosensor systems for assessing antibiotic effects on microbial cells represents a significant advancement in the fight against antimicrobial resistance. These systems offer a unique platform for real-time, label-free monitoring of antibiotic-cell interactions, allowing for a deeper understanding of drug mechanisms and microbial responses. Their versatility in accommodating diverse microorganisms and antibiotics positions them as valuable tools for guiding the development of effective therapeutic strategies. As the global health community grapples with the challenge of AMR, the integration of electroacoustic biosensor technology holds promise for informing clinical decisions, optimizing antibiotic regimens and contributing to the preservation of effective antimicrobial treatments. On-going research and refinement of these biosensor systems are essential to harness their full potential in addressing one of the most pressing challenges of our time.

Acknowledgement

None.

Conflict of Interest

There are no conflicts of interest by author.

References

1. Wang, Xiaotong, Yufei Lin, Yang Zheng and Fanping Meng. "Antibiotics in mariculture systems: A review of occurrence, environmental behavior and ecological effects." *Environ Pollut* 293 (2022): 118541.
2. Cháfer-Pericás, Consuelo, Angel Maquieira and Rosa Puchades. "Fast screening methods to detect antibiotic residues in food samples." *TrAC Trends Anal Chem* 29 (2010): 1038-1049.
3. De Oliveira, David MP, Brian M. Forde, Timothy J. Kidd and Patrick NA Harris, et al. "Antimicrobial resistance in ESKAPE pathogens." *Clin Microbiol Rev* 33 (2020): 10-1128.
4. Coates, Anthony, Yanmin Hu, Richard Bax and Clive Page. "The future challenges facing the development of new antimicrobial drugs." *Nat Rev Drug Discov* 1 (2002): 895-910.
5. O'Connell, Kieron MG, James T. Hodgkinson, Hannah F. Sore and Martin Welch, et al. "Combating multidrug-resistant bacteria: Current strategies for the discovery of novel antibacterials." *Angew Chem Int Ed* 52 (2013): 10706-10733.
6. Le Page, Gareth, Lina Gunnarsson, Jason Snape and Charles R. Tyler. "Integrating human and environmental health in antibiotic risk assessment: A critical analysis of protection goals, species sensitivity and antimicrobial resistance." *Environ Int* 109 (2017): 155-169.

How to cite this article: Smith, Blessy. “Assessing Antibiotic Effects on Microbial Cells using Electroacoustic Biosensor Systems.” *J Biosens Bioelectron* 14 (2023): 399.