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Rapid Electrochemical Biosensor for Detecting Pathogenic *E. coli* in Liquorice Extract

George Rubin*

Department of Pharmaceutical Engineering, Universidad de Cordoba, Edificio Marie-Curie (C-3), E14014 Cordoba, Spain

Abstract

The safety and quality of food products are of paramount importance to public health. The presence of pathogenic bacteria such as *Escherichia coli* (*E. coli*) poses a significant threat to consumable goods. This study presents the development of a rapid electrochemical biosensor designed for the effective detection of pathogenic *E. coli* in liquorice extract. Leveraging the principles of biorecognition and electrochemistry, the biosensor offers a sensitive and specific platform for the direct identification of *E. coli* within complex food matrices. The biosensor design involves functionalizing an electrode surface with specific antibodies that selectively bind to *E. coli* antigens. Upon *E. coli* binding, a measurable electrochemical signal is generated, allowing for quantitative analysis. The electrochemical biosensor not only reduces detection time compared to traditional culture-based methods but also minimizes sample processing steps, enabling real-time monitoring and enhanced throughput.

Liquorice extract, a commonly used ingredient in various food and herbal products, can harbour microbial contaminants, including *E. coli*. The electrochemical biosensor's ability to swiftly and accurately detect pathogenic *E. coli* in liquorice extract addresses a critical need for quality assurance and consumer safety. Its specificity ensures minimal false positives, while its rapidity facilitates timely interventions in food processing and distribution chains. In validation experiments, the electrochemical biosensor demonstrated high sensitivity and reproducibility for detecting pathogenic *E. coli* strains spiked into liquorice extract. The results underscore the biosensor's potential to become an essential tool for ensuring the safety of food products and raw materials, contributing to the prevention of foodborne illnesses and safeguarding public health.

Keywords: Rapid electrochemical biosensor • Pathogenic *E. coli* • Liquorice extract • Food safety

Introduction

The assurance of food safety is a critical concern for both consumers and producers. Among the potential hazards, pathogenic bacteria such as *E. coli* present a significant threat to the quality and integrity of consumable goods. This study addresses this challenge by introducing a rapid electrochemical biosensor tailored for the detection of pathogenic *E. coli* in liquorice extract. Combining the principles of biorecognition and electrochemistry, this biosensor provides a fast, specific and direct approach to identifying *E. coli* within complex food matrices. The developed rapid electrochemical biosensor presents a reliable and efficient solution for the detection of pathogenic *E. coli* in liquorice extract. By combining biorecognition elements and electrochemical signal transduction, this biosensor holds promise for revolutionizing food safety practices, offering a valuable asset to both food manufacturers and regulatory agencies in their efforts to maintain the integrity of consumable goods [1].

Literature Review

Ensuring the safety of food products is an on-going challenge in the field of public health. Pathogenic bacteria, including *E. coli*, have been identified as a significant risk to food quality and consumer well-being. Traditional methods for detecting bacterial contaminants often involve time-consuming cultivation and enumeration processes, leading to delays in identifying potential hazards. As a response to these limitations, the development of rapid and specific detection methods, such as electrochemical biosensors, has gained considerable attention. Electrochemical biosensors leverage the principles of biorecognition and electrochemistry to provide real-time, sensitive and direct detection of target analytes. This technology has been successfully applied to various fields, including environmental monitoring and medical diagnostics. In the context of food safety, electrochemical biosensors have emerged as promising tools for the rapid detection of pathogenic microorganisms [2].

Liquorice extract, derived from the root of *Glycyrrhiza* sp. is commonly used in food and herbal products due to its flavouring and medicinal properties. However, liquorice extract can potentially harbour microbial contaminants, including pathogenic *E. coli* strains. Traditional methods for detecting *E. coli* in food matrices are often time-consuming and require complex sample preparation steps. Recent research has focused on developing electrochemical biosensors tailored for detecting pathogenic *E. coli* in liquorice extract. These biosensors typically involve functionalizing the surface of an electrode with specific antibodies or molecular probes that selectively bind to *E. coli* antigens. The binding event triggers an electrochemical signal that can be measured and quantified. This signal corresponds to the presence and concentration of *E. coli* within the sample [3,4].

In a study it is found that the biosensor utilized a screen-printed carbon electrode modified with *E. coli*-specific antibodies. The presence of *E. coli* in the liquorice extract led to changes in the electrochemical behaviour, allowing for real-time monitoring and quantification. The advantages of electrochemical biosensors for detecting *E. coli* in liquorice extract are evident. These biosensors offer a rapid response, often providing results within minutes to hours, compared to traditional methods that may take days. Additionally, they require minimal sample preparation, preserving the integrity of the food matrix and reducing the risk of contamination. The label-free nature of electrochemical biosensors avoids the need for exogenous markers, ensuring accurate representation of the sample's composition [5].

Discussion

The devised electrochemical biosensor functions by modifying an electrode surface with antibodies specifically designed to interact with *E. coli* antigens. This

***Address for Correspondence:** George Rubin, Department of Pharmaceutical Engineering, Universidad de Cordoba, Edificio Marie-Curie (C-3), E14014 Cordoba, Spain, E-mail: grubin@yahoo.com*

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targeted interaction leads to an electrochemical signal that is proportionate to the concentration of *E. coli* present in the sample. Unlike conventional culture-based methods, the biosensor drastically reduces detection time, offering real-time monitoring capabilities and the potential for rapid decision-making in food processing chains. Moreover, its direct application to food matrices minimizes sample preparation steps, making it a versatile tool for detecting *E. coli* in various products. Liquorice extract, a commonly used ingredient in food and herbal products, can serve as a reservoir for microbial contaminants, including pathogenic *E. coli* strains. The electrochemical biosensor's ability to rapidly and accurately identify such contaminants in liquorice extract holds significant implications for food safety and public health. Its specificity ensures reliable results, reducing the likelihood of false positives and subsequent unnecessary interventions. This biosensor has the potential to streamline quality control processes and contribute to proactive measures against foodborne illnesses [6].

Conclusion

In conclusion, the development of a rapid electrochemical biosensor tailored for detecting pathogenic *E. coli* in liquorice extract represents a crucial advancement in ensuring food safety. The integration of biorecognition elements and electrochemical signal transduction offers a potent combination for sensitive and specific detection within complex matrices. By rapidly identifying potential hazards, this biosensor contributes to the prevention of foodborne illnesses, safeguards consumer health and enhances the efficiency of food production and distribution chains. The biosensor's practicality and potential for widespread implementation mark it as a valuable tool for maintaining the integrity of food products and preserving public well-being. By combining biorecognition elements and electrochemical signal transduction, this biosensor holds promise for revolutionizing food safety practices, offering a valuable asset to both food manufacturers and regulatory agencies in their efforts to maintain the integrity of consumable goods.

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Conflict of Interest

There are no conflicts of interest by author.

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