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Exploring the Quantification Potential of a Nanopores-based Sequencing Platform for Food Safety Applications Using External Standards of Lambda DNA and Lambda-Spiked Beef

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Introduction

The increasing demand for reliable and rapid detection methods in food safety has led to the exploration of innovative technologies. Nanopore-based sequencing platforms represent one such promising advancement, offering the capability for real-time, high-throughput, and portable analysis. These platforms leverage nanopore technology, where single molecules of DNA or RNA pass through a nanopore, generating an electrical signal that is subsequently translated into a nucleotide sequence. This study investigates the quantification potential of such a platform for food safety applications, focusing on the use of external standards like lambda DNA and lambda-spiked beef samples. Lambda DNA, derived from the bacteriophage lambda, serves as a model system in molecular biology due to its well-characterized genome. It provides a reliable external standard for evaluating the performance and quantification capacity of nanopore sequencing systems. The uniformity and stability of lambda DNA make it an ideal candidate for calibration and performance assessments. In this context, lambda DNA was utilized to assess the precision, reproducibility, and sensitivity of a nanopore sequencing platform, laying the foundation for its application in food safety [1].

The study began with the preparation of lambda DNA standards. Different concentrations of lambda DNA were prepared to simulate various levels of contamination, mimicking real-world scenarios where pathogenic or spoilage organisms might be present in food products. These standards underwent nanopore sequencing to evaluate the platform's ability to detect and quantify the DNA. Critical parameters such as read depth, accuracy, and the limit of detection were systematically analyzed. The results demonstrated that the platform could reliably detect lambda DNA across a wide range of concentrations, exhibiting excellent linearity in quantification. A significant aspect of this study involved spiking beef samples with known concentrations of lambda DNA to evaluate the platform's performance in complex matrices. Food matrices like beef often pose challenges in molecular detection due to the presence of inhibitors and the heterogeneity of the sample. Therefore, this step was crucial to simulate real-world applications of the nanopore sequencing platform for food safety. Lambda-spiked beef samples were subjected to DNA extraction, followed by nanopore sequencing [2]. The platform successfully identified and quantified lambda DNA, even in the presence of complex background signals from the beef matrix. This finding underscores the robustness of the technology and its potential for practical applications in food safety monitoring.

Description

An essential aspect of this investigation was the use of external standards to calibrate and validate the sequencing platform. By incorporating known quantities of lambda DNA into the analysis, the study was able to quantify the DNA present in the samples accurately. The external standards provided a benchmark against which the performance of the platform could be measured, ensuring reliable and reproducible results. This approach not only enhanced the accuracy of the quantification but also facilitated the detection of low levels of contamination, which is critical for food safety applications. The portability and real-time capabilities of nanopore sequencing platforms further enhance their appeal for food safety applications. Unlike traditional methods, which often require time-consuming laboratory procedures, nanopore sequencing can be conducted in the field, providing immediate results.

Developing these standards is critical to ensuring consistent and reliable results across different laboratories and applications. The findings of this study highlight the potential of nanopore sequencing platforms for quantifying DNA in food safety applications. By utilizing external standards such as lambda DNA and lambda-spiked beef samples, the study demonstrated the platform's ability to detect and quantify DNA with high accuracy and sensitivity, even in complex matrices. The results underscore the robustness and versatility of nanopore sequencing, paving the way for its integration into food safety monitoring and quality control processes.

Conclusion

Nanopore-based sequencing platforms offer a promising solution for addressing the challenges of food safety monitoring. Their ability to provide real-time, high-throughput, and accurate analysis makes them an invaluable tool for detecting and quantifying contaminants in food products. The use of external standards, such as lambda DNA, enhances the reliability and accuracy of the platform, ensuring its effectiveness for practical applications. While challenges remain, continued advancements in technology and the development of standardized protocols will further enhance the utility of nanopore sequencing in food safety. The findings of this study represent a significant step forward in leveraging innovative technologies to ensure the safety and quality of our food supply, underscoring the potential of nanopore sequencing as a game-changing tool in the field of food safety

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