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(UG*) (POS-22) Detection of Bacterial Pathogens in Blood Using Laser-Induced Breakdown Spectroscopy

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Rapid pathogen detection is essential for controlling infectious disease outbreaks and minimizing healthcare-associated costs worldwide. For example, delays in the diagnosis of a pathogen present in the blood (bacteremia) can contribute to increased patient mortality if the infection progresses to sepsis. Laser-induced breakdown spectroscopy (LIBS) is a relatively simple and versatile elemental analytic technique that has demonstrated the ability to quickly identify bacterial pathogens in fluids with minimal sample preparation. In this study, LIBS showed high specificity and sensitivity in not only detecting the presence of bacteria in blood samples, but also discriminating between four different species using chemometric and machine-learning algorithms.

Blood samples obtained from patients at a local hospital were intentionally spiked with known aliquots of *Escherichia coli, Staphylococcus aureus, Enterobacter cloacae*, and *Pseudomonas aeruginosa* to simulate blood infections. After deposition of these samples on inexpensive, disposable filter media, approximately 30 single-shot LIBS spectra were acquired per filter. The intensities of fifteen emission lines from Ca, Mg, Na, C, and P were obtained from each spectrum, and these intensities were used as variables in the subsequent data analysis. Partial least squares discriminant analysis (PLS-DA) was used to discriminate between spectra acquired from sterile control samples and those infected with bacteria. This test possessed a 96.3% sensitivity and 98.6% specificity. The LIBS spectrum from 200 nm –590 nm was input into an artificial neural network analysis with principal component analysis pre-processing (PCA-ANN) to diagnose the bacterial species once detected. PCA-ANN performed on these spectra returned an average sensitivity of 85.5%, an average specificity of 95.0%, and a classification accuracy of 92.5%. These results highlight the capability of LIBS to be a rapid and reliable method for the diagnosis of blood infections. This result has the potential to significantly reduce testing times compared to conventional laboratory methods, minimizing patient suffering and reducing global healthcare costs.

Keyword-1

LIBS Spectroscopy

Keyword-2

Bacteria

Keyword-3

Blood

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