Fourier transform infrared microspectroscopy as a dynamic tool in rapid identification of clinically and hospital relevant microorganisms

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Abstract:
Infectious diseases are one of the most frequent causes of mortality worldwide lagging only behind heart disease, stroke and cancer. In addition, they frequently occur in critically ill hospitalized patients, with commonly reported infections in places such as the bloodstream, urinary-tract, respiratory-tract, intra-abdominal sites, and surgical wounds. Consequences originate from this infections such as sepsis is estimated to increase, especially in the elderly patients, patients infected with microorganisms resistant to treatment, patients with weakened immune systems (AIDS patients), or those undergoing long, high-risk surgery [1,2]. Notwithstanding time required for identification of pathogens is an important factor in mortality rates and in clinical practice. However, traditional methods and procedures for the identification of the infectious agent can take days, thereby causing serious complications in patients until the preliminary diagnosis is either confirmed or refuted. Infrared spectroscopy is a method that provides a biochemical characterization of the cellular components of the sample, such as proteins, nucleic acids, carbohydrates, lipids, and cellular components. Thus, small variations in the different biochemical microorganisms can be used for identification. Many studies with different microorganisms, with minor variations in technique and sample preparation have been undertaken to identify clinically relevant pathogens [3,4]. In this study, American Type Culture Collection Gram-positive bacterial strains of *Escherichia coli* 10799, *Proteus mirabilis* 25933, and *Pseudomonas aeruginosa* 15442 and Gram-negative bacterial strains of *Staphylococcus aureus* 14456, *Staphylococcus epidermidis* 9300, and *Enterococcus faecalis* 10100 with 6 hours of culture were analyzed by infrared spectroscopy. The spectra were obtained in transmission mode in the range from 4000 to 900 cm^{-1} with 32 scans and a resolution of 4 cm^{-1} with a spectrophotometer using the Spectrum Spotlight 400 FT-IR (Perkin Elmer). The spectra showed significant differences among Gram-positive and Gram-negative bacteria in several vibrational regions. In cluster analysis, three discriminated spectral regions were selected, 3000-2800 cm^{-1}, 1470-1410 cm^{-1}, and 1176-950 cm^{-1} with 100% of samples correctly classified showing the effectiveness of the method in microbiology.

References

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