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Raman Spectroscopy Applications for Bacterial Detection: Potential & Challenges towards Development of Field Deployable System

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Abstract

There is a need to develop rapid, non-invasive and specific methods that can detect and identify the presence of airborne, foodborne or waterborne pathogens and toxins with high precision. Conventional methods include standard biochemical methods such as enzymatic activity, gas production and compound metabolism for identification of bacteria. The biochemical methods mentioned above are time consuming and require extensive sample preparation. Raman spectroscopy is a well established vibrational spectroscopy technique which is bond specific and enables to obtain molecular information of samples. Raman based methods are non-invasive, preferably label-free and non-destructive.

Biological samples are complex systems and are constituted of a number of biomolecules such as proteins, lipids, carbohydrates and nucleic acids. Raman spectroscopic analysis can provide distinct spectral fingerprint unique to the biomolecules. Therefore, the spectral markers can be used for identification of pathogens [1-3]. In addition, combination of multivariate approach can improve classification accuracy. The prediction process can be enhanced and automated by combining this technique with chemometric analysis [4]. Offshoots of Raman spectroscopy such as surface enhanced Raman spectroscopic (SERS) approach can increase the sensitivity of detection for analysis of low concentration of pathogens [5]. Although rapid progress has been made on the instrumentation of Raman spectroscopy based methods, it has been a challenging issue so far to differentiate and detect pathogenic strains from non-pathogens of the same species. In this talk, the work carried out in this laboratory to address the issue of identification of pathogens shall be presented. The potential and limits of Raman spectroscopy based technology for detection of pathogens in real environment will be discussed. Examples will be shown where Raman micro spectroscopy in combination with chemometric method has been used to classify different strains of bacteria & genomic DNA.

Keywords: Raman spectroscopy, Pathogen detection, Multivariate analysis

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