Indian Institute of Science

Centre for BioSystems Science and Engineering

Annual Work Presentation

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MRDG Seminar Hall, 1st Floor, Biological Sciences Building

Raman spectroscopic studies on bacteria: from strain identification to tracking antibiotic resistance

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Abstract

Raman spectroscopy is a form of vibrational spectroscopy, which is based on the principle of inelastic scattering of monochromatic light, such as lasers. Traditionally, this technique was used in chemistry to provide a structural fingerprint of molecules. However, over the past two decades, several applications of Raman spectroscopy in the field of biology and medicine have emerged. The usefulness of this method stems from the fact that it is minimally-invasive, label free and non-destructive. Biological samples are complex and are made up of several biomolecules like proteins, lipids, carbohydrates and nucleic acids. These molecules have unique structures and therefore yield unique spectral fingerprints which can be tracked during disease or any other biological process. In the field of microbiology, Raman spectroscopy has been largely used for the identification of clinically and environmentally important bacteria. Very recently, this versatile technique has found potential in the detection of antimicrobial resistance.

In this work, two microbiological applications of Raman spectroscopy will be discussed. The first part involves differentiating two very closely related strains of the Mycobacterial species, namely Mycobacterium indicus pranii and Mycobacterium intracellulare. M. indicus pranii is believed to be a strain of M. intracellulare since their 16s rRNA sequence is completely identical. Using Raman spectroscopy and multivariate data analysis, we could differentiate these two bacterial species based on their phenotypic profiles.

The second part of the talk focusses on the potential of Raman spectroscopy in tracking phenotypic antibiotic resistance. Sodium salicylate, an analgesic, is known to induce antibiotic resistance in bacteria via the upregulation of the AcrAB-TolC efflux pump that pumps out antibiotic from the bacterial cell. Using a combinatorial approach of commonly used microbiological methods and Raman spectroscopy, we demonstrate the potential of this technique in profiling antibiotic resistance, developed as a result of treatment with sodium salicylate, in E. coli.