World Academy of Science, Engineering and Technology
International Journal of Physical and Mathematical Sciences
Vol:11, No:06, 2017

Detection and Identification of Antibiotic Resistant Bacteria Using Infra-Red-Microscopy and Advanced Multivariate Analysis

Authors : Uraib Sharaha, Ahmad Salman, Eladio Rodriguez-Diaz, Elad Shufan, Klaris Riesenberg, Irving J. Bigio, Mahmoud Huleihel

Abstract : Antimicrobial drugs have an important role in controlling illness associated with infectious diseases in animals and humans. However, the increasing resistance of bacteria to a broad spectrum of commonly used antibiotics has become a global health-care problem. Rapid determination of antimicrobial susceptibility of a clinical isolate is often crucial for the optimal antimicrobial therapy of infected patients and in many cases can save lives. The conventional methods for susceptibility testing like disk diffusion are time-consuming and other method including E-test, genotyping are relatively expensive. Fourier transform infrared (FTIR) microscopy is rapid, safe, and low cost method that was widely and successfully used in different studies for the identification of various biological samples including bacteria. The new modern infrared (IR) spectrometers with high spectral resolution enable measuring unprecedented biochemical information from cells at the molecular level. Moreover, the development of new bioinformatics analyses combined with IR spectroscopy becomes a powerful technique, which enables the detection of structural changes associated with resistivity. The main goal of this study is to evaluate the potential of the FTIR microscopy in tandem with machine learning algorithms for rapid and reliable identification of bacterial susceptibility to antibiotics in time span of few minutes. The bacterial samples, which were identified at the species level by MALDI-TOF and examined for their susceptibility by the routine assay (micro-diffusion discs), are obtained from the bacteriology laboratories in Soroka University Medical Center (SUMC). These samples were examined by FTIR microscopy and analyzed by advanced statistical methods. Our results, based on 550 E.coli samples, were promising and showed that by using infrared spectroscopic technique together with multivariate analysis, it is possible to classify the tested bacteria into sensitive and resistant with success rate higher than 85% for eight different antibiotics. Based on these preliminary results, it is worthwhile to continue developing the FTIR microscopy technique as a rapid and reliable method for identification antibiotic susceptibility.

Keywords : antibiotics, E. coli, FTIR, multivariate analysis, susceptibility
Conference Title : ICHRMS 2017 : International Conference on High Resolution Molecular Spectroscopy
Conference Location : Copenhagen, Denmark
Conference Dates : June 11-12, 2017