Matrix-Assisted Laser Desorption Ionization Mass Spectrometer (MALDI-TOF MS) based Antibiotic Susceptibility Testing

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Antimicrobial resistance (AMR) is on the rise and has become a worldwide problem that needs an urgent attention. This issue is due to number of factors such as the miss-use of antibiotics and the need for fast and reliable tools for AMR detection. Clinical microbiology laboratories play a key role in guiding decisions for treating infections. This can be achieved by performing bacterial identification testing from clinical samples followed by antibiotic susceptibility testing (AST). Traditional approaches for bacterial identification and AST as phenotypic based and can be time consuming. Recently, matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDITOF MS) has replaced the conventional methods for bacterial identification. This is because it is simple to use, and able to provide instant and more reliable results. MALDITOF MS also has the potentiality to be used for AST. Different approaches by MALDITOF MS have been developed for the detection of antibiotic resistance including molecular, chemical and proteomic based methods. This paper will review the most advanced techniques including, the MALDI Biotyper-Selective Testing of Antibiotic Resistance-Beta- Lactamase Assay (MBT-STAR), MALDI Biotyper-Resistance Test with Stable Isotopes Assay (MBT-RESIST) and the MALDI Biotyper antibiotic susceptibility test rapid assay (MBT-ASTRA). The MBT-STAR-BL assay is heavily used for the detection of beta lactamase producers. However, the MBT-ASTRA seems more promising due to the applicability of the assay against all resistance mechanisms since that only the relative growth is assessed. The literature review will briefly highlight the application of MALDI-TOF MS and its utility for bacterial identification. The literature review will also focus in details on the potential use of MALDI-TOF MS for AST by all of the different approaches. Lastly, other MS-type platforms that have been used in AST will also be briefly addressed.

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Next Generation Antibiotic Susciptability Testing (Ngast): The Potential Use of Matrix-Assisted Laser Desorption Ionization Mass Spectrometer as a Tool for Rapid Antibiotic Susceptibility Testing

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Background and Purpose: Antimicrobial Resistance (AMR) is a worldwide issue that needs to be tackled. Recently Matrix-Assisted-Laser-Desorption/Ionization Mass-Spectrometry (MALDI-TOF MS) has revolutionized the clinical microbiology field in routine labs for bacterial identification. Alongside this great feature, MALDI-TOF MS seems to have the potentiality to be used to provide rapid antibiotic susceptibility results. In this study we used the MALDI Biotyper Antibiotic Susceptibility Test Rapid Assay (MBT-ASTRA due to its simplicity and suitability to be used against bacteria with different resistance mechanisms.

Methods: The MBT-ASTRA was used for testing bug-drug combination from preliminary studies to validate the robustness of this technique on a MALDI-TOF MS (AB SCIEX). Four strains of Klebsiela pneumoniae and Pseudomonas aeruginosa (including 2 sensitive strains and 2 resistant strains for each bug) were tested against 64 μg/ml of meropenem with an incubation time of one and two hours, respectively. In addition, Escherichia coli was tested against ciprofloxacin at a concentration of 32 μg/ml with two hours of an incubation. The study also involved in optimizing four new bug-drug combinations which included E. coli against colistin and gentamicin and P. aeruginosa against gentamicin and ciprofloxacin.

Results: The results showed a clear discrimination between the different strains. As well as a significant discrimination for E. coli against gentamicin within one hour of an incubation time at a concentration of 64 μg/ml. On the other hand, some of P. aeruginosa results demonstrated false negative result (i.e., the growth rate measurement of the sensitive strain was increased in the presence of antibiotics).

Conclusion: In conclusion, this study demonstrates the potentiality of the MBT-ASTRA in the rapid detection of AMR. This technique is simple, fast and applicable to all the resistant mechanisms. However, rigorous optimization for the bacterial protein extraction, drug concentration and incubation time are critical to insure reproducibility of the assay.

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