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Tandem mass spectrometry as a tool for tailoring animal disease diagnostics based on biomarker discovery: Molecular imprinting approach

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Zoonotic and transboundary animal disease control is a top priority in many health concerned organizations/institutions. The identification of the diversity of animal disease biomarkers or epitopic fractions like proteins, glycoproteins and lipopolysaccharides has a potential diagnostic/therapeutic importance. Biomarker discovery and proteomics have become synonymous with mass spectrometry in recent years. Tandem Mass Spectrometer (MS-MS) is a multistage mass analysis steps that may be either separated in space using multiple instruments or separated in time using a single mass hybrid spectrometer. MS-MS techniques starting from ion-trap (IT) to MALDI-TOF MS or their hybrid techniques are powerful platforms for proteomics analysis have been developed over the past decades. Comprehensive array of antibodies, recombinant proteins, epitopes or haptens that can be used in innovating diagnostics of animal diseases and to monitor animal health are widely being investigated. Various analytical strategies have been developed for mass spectrometry-based biomarker-discovery platforms to overcome many challenges and biological variability and anomalies. Biorecognition is central to various biological processes and finds numerous applications (sensors/affinity separation and synthetic catalysis) in virtually all areas of chemistry, biology and medicine. Scientists have been working for decades to mimic the exquisite molecular recognition ability of biological molecules such as antibodies, enzymes and receptors. Artificial antibodies, produced by imprinting synthetic polymers are designed to mimic the biological (biomimetic) recognition capability of natural antibodies, while exhibiting superior thermal, chemical and environmental stability compared to their natural counterparts. The binding affinity of artificial antibodies to their antigens characterizes the biorecognition ability of these synthetic nanoconstructs and their ability to replace natural recognition elements. However, a quantitative study of the binding affinity of an artificial antibody to an antigen, especially at the molecular level is still lacking. Several international organizations such as WHO, OIE, FAO and EPA called upon the development of rapid, sensitive, low cost and easy to use early diagnosis of pathogens rapid field test or point of care diagnostics. The detection and monitoring diseases has been a huge burden due to the high cost of reagents, laboratory sophisticated equipment and trained personnel. Most expenses spent for disease diagnoses go to analytical and diagnostic devices. Moreover, laboratories are hard to find in remote epidemic areas. There has been tremendous development and advancements in the field of molecular biology, nanotechnology and bioelectromechanical Microsystems (BioMEMS). These advanced technologies led to the development of bio-microchip devices for the detection of chemical and biological hazards. Lab-on-a-chip technique is one of the top emerging technologies. Proteins will be identified by mass spectrometry-based proteomic methods. The successful candidate will have significant product for development of clinical immunoassays and/or biomimetic sensors gained within the regulated immunodiagnostic products industry, ideally in the development of lateral flow assay (LFA) kit based products. Computational chemistry tools will aid this developmental approach upon conformational decisions of antigenic fractions that have diagnostic importance. Development and production of rapid point-of-care tests for the global veterinary diagnostics market is the golden goal to be reached.

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