Tandem Mass Spectrometry: New frontiers of veterinary theranostics based on molecular imprinting

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Abstract:

Research in molecular biomimetics is multidisciplinary and provides molecular tools for applications in diverse fields of basic sciences, engineering and medicine. The molecular biomimetic approach opens up new avenues for the design and utilization of multifunctional molecular systems with wide ranging applications, from tissue engineering/regenerative, drug delivery and biosensors to nanotechnology and bioremediation. The identification of the diversity of animal disease biomarkers or epitopic/motifs fractions; like proteins, glycoproteins and lipopolysccarides has a potential diagnostic/ therapeutic (theranostic) importance. Biomarker discovery based on hyphenated tandem mass spectrometric techniques has been revolutionized in recent years. Various analytical strategies have been developed for mass spectrometry based on biomarker discovery platforms to overcome many challenges and biological variabilities and abnomalies.

Molecular biomimetics could be a strategic initiative to combine clinical and basic researches into a directed application toward theragnosis. The concept of personalized medicine has gained a lot of press in the last few years and is an area of active research in the pharmaceutical and diagnostic industries. This has been partly fuelled by the maturation of the "omics mass spectrometric technologies" (figure 1) which have facilitated the classification and understanding of diseases at the molecular level, the identification of new therapeutic targets and the discovery of biomarkers to predict and monitor drug response.

Sensors based on biological and/or synthetic molecules and their interfaces with nanomaterials in biochips, bio-sensing nanotechnologies for biomimetic chips, nanodevices and systems based on molecularly imprinted /bio polymer- nanocomposites of biomolecular recognitions capabilities for versatile biomedical applications. In the recent years, imprinted polymers have been used to capture/recognize everything from macromolecules to inorganic ions. Recognition plays an important role in biological systems and is observed in between receptor- ligand, antigen-antibody, DNA-protein, sugar-lectin, RNA-ribosome, substrate-enzyme etc..(figure 2). Molecular Imprinted Polymers (MIPs) have been applied as artificial antibodies, catalysts, biomemtic sensors, drug assay/ delivery tools, and chromatographic affinity separations. Finally, MIP is science goes market upon business analysis based on patents.

The scope of this article will include but not inclusive to:

- Tandem mass techniques starting from ion-trap to TOF and their hybrids as powerful platforms for biomarker (omics) discovery over the past decades.
- Design of biomimetic materials with a bottom-up approach using building blocks inspired by biological macromolecules for theranostic applications.

- State of art molecular imprinted polymers based sensors for on-site monitoring ,affinity separation , catalysis and smart drug delivery
- Self-assembling of bio/biomimetic/nanomaterials composites and their biocompatibility, biodistribution, biodegradability and drug delivery using powerful tool for full characterization by mass spectrometric techniques.
- Clues on biosensors/biomimetic sensors platforms for theranostic applications [point of care devices (POC), Lateral flow immunoassay (LFA), Lab on a chip (LOC), molecular imaging, wireless sensors networks (WSNs), Bio-MEMS and nanorobots]

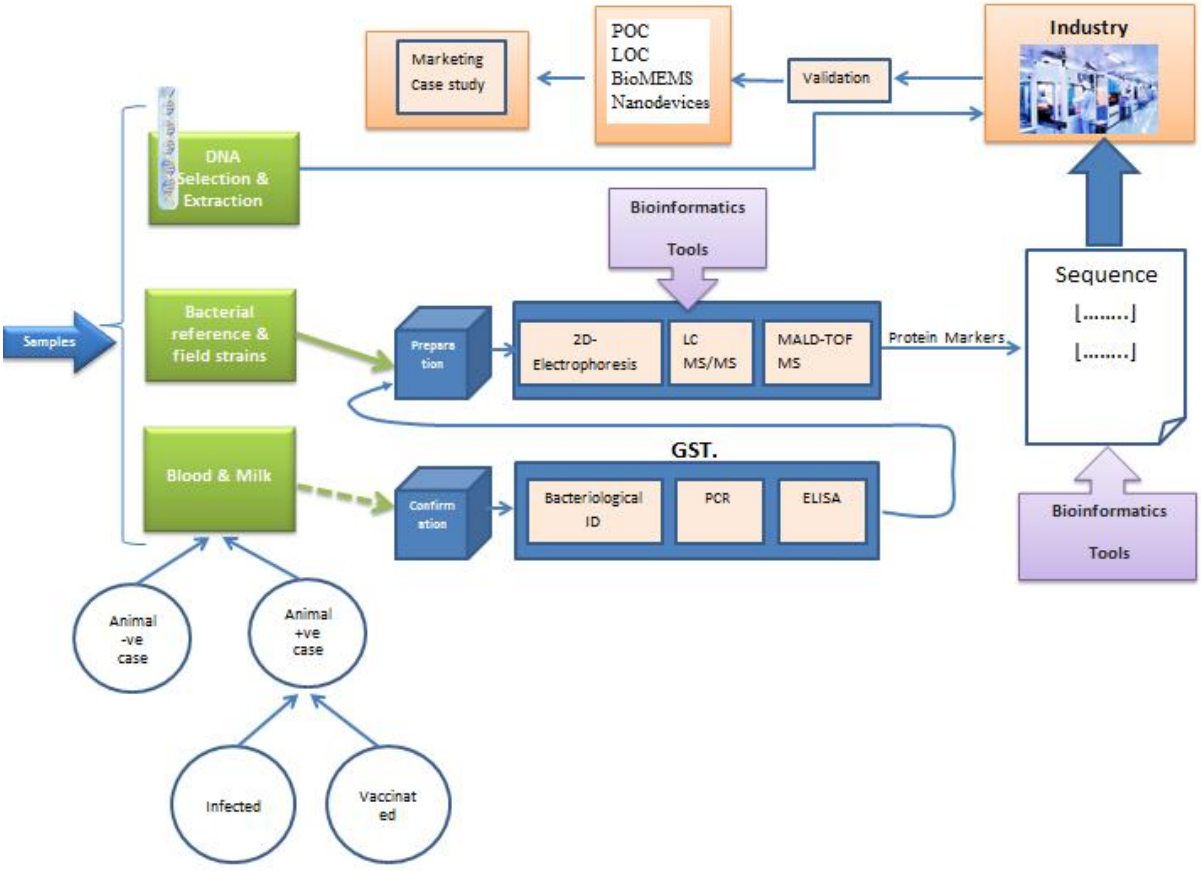


Figure 1. Development of tailor-made veterinary theranostics flow diagram.

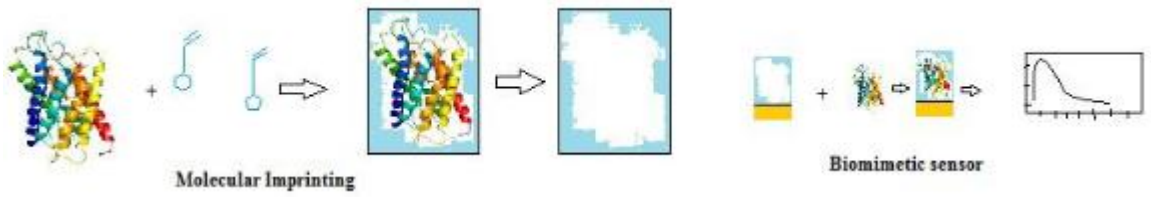


Figure 2. Protein/macromolecules molecular imprinting (MIP)/sensors development

Keywords:
Tandem mass spectrometry, bioinformatics, proteomics, veterinary theranostics, molecular imprinting, Lab on a chip, BioMEMES, Biomimetic sensors, nanocomposites, smart delivery