11 February 2010

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Chem-Bio News - S&T Edition

1. QUANTITATIVE MULTIPLEX DETECTION OF PATHOGEN BIOMARKERS ON MULTICHANNEL WAVEGUIDES: *"Evaluation of the multichannel waveguide shows an excellent concordance with single-channel data and effective, simultaneous, and reproducible measurement of lethal toxins in three samples.*"

2. A SOL-GEL-BASED AMINO FUNCTIONALIZED FIBER FOR IMMERSED SOLID-PHASE MICROEXTRACTION OF ORGANOPHOSPHORUS PESTICIDES FROM ENVIRONMENTAL SAMPLES: *"The developed method was successfully applied to real water samples while the relative recovery percentages obtained for the spiked water samples were from 80 to 115%.*"

3. THE ROLE OF THE VASCULAR ENDOTHELIUM IN ARENAVIRUS HAEMORRHAGIC FEVERS: "*These studies provided first possible links to some of the vascular abnormalities observed in patients; however, their relevance in vivo remains to be investigated.*"

4. A QUANTUM CHEMICAL STUDY OF REACTIONS OF DNA BASES WITH SULPHUR MUSTARD: A CHEMICAL WARFARE AGENT: *"Formation of adducts at the N7 site of guanine and N3 site of adenine are found to be most favored and next most favored respectively, which agrees with experimental observations.*"

5. DISCRIMINATION AND PHYLOGENOMIC CLASSIFICATION OF BACILLUS ANTHRACIS-CEREUS-THURINGIENSIS STRAINS BASED ON LC-MS/MS ANALYSIS OF WHOLE CELL PROTEIN DIGESTS: *"The proposed approach could be used as an alternative method for predicting relatedness among microbial genomes of B. cereus group members and potentially may circumvent the need for whole genome sequencing for phylogenomic typing of strains.*"

6. YERSINIA PESTIS TWO-COMPONENT GENE REGULATORY SYSTEMS PROMOTE SURVIVAL IN HUMAN NEUTROPHILS: *"Iterative analysis with Y. pestis strains lacking the PhoP-regulated genes ugd and pmrK indicated that the mechanism most likely responsible for increased resistance to killing is 4-amino-4-deoxy-l-arabinose modification of lipid A."*

7. DNA SEQUENCING ON A CHIP: *"In Huang's method, fluorescently labelled nucleotides are randomly incorporated into the DNA during replication."*

CB Daily Report

Chem-Bio News

QUANTITATIVE MULTIPLEX DETECTION OF PATHOGEN BIOMARKERS ON MULTICHANNEL WAVEGUIDES
Journal of Technology & Science
February 14, 2010

"""No single biomarker can accurately predict disease. An ideal biodetection technology should be capable of the quantitative, reproducible, and sensitive detection of a limited suite of such molecules."

"To this end, we have developed a multiplex biomarker assay for protective antigen and lethal factor of the Bacillus anthracis lethal toxin using semiconductor quantum dots as the fluorescence reporters on our waveguide-based biosensor platform. The platform is extendable to a wide array of biomarkers, facilitating rapid, quantitative, sensitive, and multiplex detection, better than achievable by conventional immunoassay. Our assay allows for the sensitive (limit of detection 1 pM each), specific (minimal nonspecific binding), and rapid (15 min) detection of these biomarkers in complex biological samples (e.g., serum). To address the issue of reproducibility in measurement and to increase our sample throughput, we have incorporated multichannel waveguides capable of simultaneous multiplex detection of biomarkers in three samples in quadruplicate. In this paper, we present the design, fabrication, and development of multichannel waveguides for the simultaneous detection of lethal factor and protective antigen in serum."

"Evaluation of the multichannel waveguide shows an excellent concordance with single-channel data and effective, simultaneous, and reproducible measurement of lethal toxins in three samples."

The full article can be found at: (H. Mukundan, et. al., "Quantitative Multiplex Detection of Pathogen Biomarkers on Multichannel Waveguides". Analytical Chemistry, 2010;82(1):136-144). Link not available.
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A SOL-GEL-BASED AMINO FUNCTIONALIZED FIBER FOR IMMERSED SOLID-PHASE MICROEXTRACTION OF ORGANOPHOSPHORUS PESTICIDES FROM ENVIRONMENTAL SAMPLES
Journal of Technology & Science
February 14, 2010

"A method based on immersed solid-phase microextraction (SPME) and gas chromatography mass spectrometry detection (GC-MS) for the determination of organophosphorous pesticides (OPPs) in aqueous samples was developed. A sol-gel based coating fiber was prepared using 3-(trimethoxysilylpropyl) amine as precursor," scientists in Iran report."

"The synthesized fiber was prepared in a way to impart polar moiety into the coating network and would be more suitable for extracting polar and semi-polar organic pollutants. Important parameters influencing the extraction process were optimized and an extraction time of 40 min at 30 degrees C gave maximum peak area, when NaCl (20% w/v) was added to the aqueous sample. The linearity for disulfoton, phorate and sulfotep was in the concentration range of 0.01 to 5 ng mL(-1) and for parathion and O,O,O-triethylthiphosphate was in the range of 0.01 to 50 ng mL(-1). Limits of detection ranged from 1 ng L-1, for parathion, to 0.05 ng L-1, for disulfoton using time-scheduled selected ion monitoring (SIM) mode, and the RSD% values were all below 10.5% at the 1 ng mL(-1) level."

"The developed method was successfully applied to real water samples while the relative recovery percentages obtained for the spiked water samples were from 80 to 115%."

The full article can be found at: (H. Bagheri, et. al., "A sol-gel-based amino functionalized fiber for immersed solid-phase microextraction of organophosphorus pesticides from environmental samples". Microchemical Journal, 2010;94(1):1-6). Link not available.
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THE ROLE OF THE VASCULAR ENDOTHELIUM IN ARENAVIRUS HAEMORRHAGIC FEVERS
Hospital Business Week
February 14, 2010

"On the South American continent, the New World arenavirus Junin virus (JUNV), Machupo (MACV), Guanarito (GTOV), and Sabia virus (SABV) have emerged as causative agents of severe VHFs. Clinical and experimental studies on arenavirus VHF have revealed a crucial role of the endothelium in their pathogenesis. However, in contrast to other VHFs, haemorrhages are not a salient feature of Lassa fever and fatal cases do not show overt destruction of vascular tissue. The functional alteration of the

vascular endothelium that precede shock and death in fatal Lassa fever may be due to more subtle direct or indirect effects of the virus on endothelial cells. Haemorrhagic disease manifestations and vascular involvement are more pronounced in the VHF caused by the South American haemorrhagic fever viruses. Recent studies on JUNV revealed perturbation of specific endothelial cell function, including expression of cell adhesion molecules, coagulation factors, and vasoactive mediators as a consequence of productive viral infection."

"These studies provided first possible links to some of the vascular abnormalities observed in patients; however, their relevance in vivo remains to be investigated."

The full article can be found at: (S. Kunz, et. al., "The role of the vascular endothelium in arenavirus haemorrhagic fevers". Thrombosis and Haemostasis, 2009;102(6 Sp. Iss.):1024-1029). Link not available.
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A QUANTUM CHEMICAL STUDY OF REACTIONS OF DNA BASES WITH SULPHUR MUSTARD: A CHEMICAL WARFARE AGENT
Journal of Technology & Science
February 14, 2010

"Reactions of the sulphonium ion of sulphur mustard (SM+1) at the N7, N3 and O6 sites of guanine, N7, N3 and N1 sites of adenine, O2 and N3 sites of cytosine and O2 and O4 sites of thymine were studied theoretically in gas phase and aqueous media employing density functional theory (DFT) and second order Moller-Plesset perturbation (MP2) theory. The B3LYP, B3PW91 and B1B95 functionals of DFT and the 6-31+G* and AUG-cc-pVDZ basis sets were used in the calculations."

"Basis set superposition error was treated using the counterpoise method by single point energy calculations at the B3LYP/6-31+G* level in gas phase. The present study explains the mechanism of alkylation of the DNA bases and shows that SM+1 would form stable adducts at the endocyclic nitrogen sites of the DNA bases, and at the O6 site of guanine and the O2 site of cytosine."

"Formation of adducts at the N7 site of guanine and N3 site of adenine are found to be most favored and next most favored respectively, which agrees with experimental observations."

The full article can be found at: (P.K. Shukla, et. al., "A quantum chemical study of reactions of DNA bases with sulphur mustard: a chemical warfare agent". Theoretical Chemistry Accounts, 2010;125(3-6):269-278). Link not available.
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DISCRIMINATION AND PHYLOGENOMIC CLASSIFICATION OF BACILLUS ANTHRACIS-CEREUS-THURINGIENSIS STRAINS BASED ON LC-MS/MS ANALYSIS OF WHOLE CELL PROTEIN DIGESTS
Journal of Technology & Science
February 14, 2010

"Modem taxonomy, diagnostics, and forensics of bacteria benefit from technologies that provide data for genome-based classification and identification of strains; however, full genome sequencing is still costly, lengthy, and labor intensive. Therefore, other methods are needed to estimate genomic relatedness among strains in an economical and timely manner."

"Although DNA-DNA hybridization and techniques based on genome fingerprinting or sequencing selected genes like 16S rDNA, gyrB, or rpoB are frequently used as phylogenetic markers, analyses of complete genome sequences showed that global measures of genome relatedness, such as the average genome conservation of shared genes, can provide better strain resolution and give phylogenies congruent with relatedness revealed by traditional phylogenetic markers. Bacterial genomes are characterized by a high gene density; therefore, we investigated the integration of mass spectrometry-based proteomic techniques with statistical methods for phylogenomic classification of bacterial strains.

For this purpose, we used a set of well characterized Bacillus cereus group strains isolated from poisoned food to describe a method that relies on liquid chromatography-electrospray ionization-tandem mass spectrometry of tryptic peptides derived from whole cell digests. Peptides were identified and matched to a prototype database (DB) of reference bacteria with fully sequenced genomes to obtain their phylogenetic profiles. These profiles were processed for predicting genomic similarities with DB bacteria estimated by fractions of shared peptides (FSPs). FSPs served as descriptors for each food isolate and were jointly analyzed using hierarchical cluster analysis methods for revealing relatedness among investigated strains. The results showed that phylogenomic classification of tested food isolates was in consonance with results from established genomic methods, thus validating our findings."

"The proposed approach could be used as an alternative method for predicting relatedness among microbial genomes of B. cereus group members and potentially may circumvent the need for whole genome sequencing for phylogenomic typing of strains."

The full article can be found at: (J.P. Dworzanski, et. al., "Discrimination and Phylogenomic Classification of Bacillus anthracis-cereus-thuringiensis Strains Based on LC-MS/MS Analysis of Whole Cell Protein Digests". Analytical Chemistry, 2010;82(1):145-155). Link not available.
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YERSINIA PESTIS TWO-COMPONENT GENE REGULATORY SYSTEMS PROMOTE SURVIVAL IN HUMAN NEUTROPHILS
Medical Letter on the CDC & FDA
February 14, 2010

"The specific molecular mechanisms used by Y. pestis to survive following phagocytosis by human PMNs are incompletely defined. To gain insight into factors that govern Y. pestis intracellular survival in neutrophils, we inactivated 25 two-component gene regulatory systems (TCSs) with known or inferred function and assessed susceptibility of these mutant strains to human PMN granule extracts. Y. pestis strains deficient for PhoPQ, KdpED, CheY, CvgSY, and CpxRA TCSs were selected for further analysis, and all five strains were altered for survival following interaction with PMNs. Of these five strains, only Y. pestis DeltaphoPQ demonstrated global sensitivity to a panel of seven individual neutrophil antimicrobial peptides and serine proteases. Notably, Y. pestis DeltaphoPQ was deficient for intracellular survival in PMNs. Iterative analysis with Y. pestis strains lacking the PhoP-regulated genes ugd and pmrK indicated that the mechanism most likely responsible for increased resistance to killing is 4-amino-4-deoxy-l-arabinose modification of lipid A."

The full article can be found at: (J.L. O'Loughlin, et. al., "Yersinia pestis two-component gene regulatory systems promote survival in human neutrophils". Infection and Immunity, 2010;78(2):773-82). Link not available
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DNA SEQUENCING ON A CHIP
By Philippa Ross
Highlights in Chemical Biology
February 10, 2010

"Scientists in the US have developed a cheap and easy to use DNA sequencing method to help with medical diagnosis.

Genome sequencing is a costly but important tool in biomedical research used for the study of genetic disease and cancer. Common sequencing methods only sequence one or two DNA bases at a time in several cycles, which makes them costly to run in terms of time and reagents required. Now Xiaohua Huang and colleagues at the University of California, San Diego have come up with a sequencing technique called sequencing by denaturation (SBD), which can be performed on a chip with a single integrated microfluidic device.

In Huang's method, fluorescently labelled nucleotides are randomly incorporated into the DNA during replication. This results in fragments of different lengths, each labelled with a fluorescent molecule corresponding to its ending base type. Next these fragments are heated and, because shorter fragments have a lower melting temperature, sequentially denatured from the shortest fragment to the longest. By monitoring the decrease in fluorescence during this process, the signal can be analyzed to determine the base sequence of the target DNA template."

The full article can be found at:
http://www.rsc.org/Publishing/Journals/cb/Volume/2010/03/dna_sequencing.asp
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