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Towards optimal sample clean-up in molecular diagnostic assays

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This work presents preliminary results of a selective, sensitive and efficient sample clean-up method based on a newly developed molecularly imprinted electrospun nanofiber solid phase extraction (SPE) sorbent that was fabricated in our laboratory. Current molecular diagnostic assay methods face a challenge of lack of direct and accurate analysis despite employing sensitive, hyphenated analytical instruments with quantification and detection limits down to femto level. The lack of direct and accurate analysis is due to the fact that biological samples are characterized by dirty and complex matrices which often introduce severe disturbances in the analytical separation and detection steps. Of consequence, quantitative analysis can only be achieved after an efficient and extensive clean-up steps' prior to instrumental analysis. To achieve this, sample handling strategies relying on selective, sensitive, robust, cheap and intelligent functional materials are needed prior to separation and detection. An example of such materials has recently been identified as molecularly imprinted polymers (MIPs). MIPs are synthetic, nano-porous polymers possessing specific cavities designed to capture a target analyte. In our quest for optimal sample clean-up strategies, we combined molecular imprinting and electrospinning technologies to fabricate very selective and sensitive polymer materials, respectively in the form of nanofibers for the selective removal of bile salts especially cholic acid and hemoglobin that interfere with the accurate instrumental analysis of trace biomarkers, drug residues or their metabolites in the human bile or blood samples, respectively. Two different and independent nanofiber materials were synthesized. The synthesized molecularly imprinted electrospun nanofibers for cholic acid and hemoglobin removal were employed as SPE sorbents and their performance in removing cholic acid and hemoglobin, respectively were compared to custom made MIP powder (micro-particles) counterparts, also prepared to remove interfering cholic acid and hemoglobin prior to instrumental analysis. The results showed 100% cholic acid and 69% hemoglobin removal by the MIP nanofibers from standard solutions relative to 80% cholic acid and 51% hemoglobin removal by the MIP micro particles. Therefore, these preliminary results open the possibility of moving from particle based SPE to fabricating more sensitive and selective MIP nanofiber based SPE sorbents with specific chemistries for removing interfering bile salts at ultra-trace concentrations in molecular diagnostic analysis of human bile samples for trace biomarkers, drug residues or their metabolites analysis. For the hemoglobin removal we recommend a combination of centrifugation and the MIP materials in order to attain optimal clean-up of blood samples prior to instrumental analysis. This would result in more accurate analysis as well as low maintenance work of the instrument and low maintenance cost which often run into several thousand US dollars.

Biography

Bareki Shima Batlokwa is a Senior Lecturer of Analytical Chemistry and an acting HOD of the Department of Chemical and Forensic Sciences at the Botswana International University of Science and Technology (BIUST), Botswana. His research interest is on the development of nanomaterials in the form of polymer powders, nanofibers, nano particles, films and quantum dots for application as screening tools in molecular diagnostics, food safety, water filtration as well as sample clean-up and purification for accurate analysis of complex samples of biological, medical, pharmaceutical, food and environmental origin.

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