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Fabric Phase Sorptive Extraction: A green sample preparation technique for pharmacokinetics, pharmacodynamics, toxicokinetics, and therapeutic drug monitoring studies directly from whole blood

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Most of the pre-clinical and clinical studies in drug discovery and development processes involve a series of experiments including pharmacokinetics (PK), pharmacodynamics (PD), toxicokinetics (TK), and therapeutic drug monitoring (TDM). Due to the distinctive complexity of whole blood as the sample matrix, either plasma or serum are used as the primary sample in pre-clinical and clinical research as the proxy for whole blood. During the transformation of whole blood into plasma or serum followed by extraction of targeted drug(s) and their metabolites using conventional sample preparation techniques including solid phase extraction (SPE) and liquid-liquid extraction (LLE), a significant portion of the analytical information disappears, resulting in questionable data in these critical studies. Fabric phase sorptive extraction (FPSE), a new generation sample preparation technology, has offered a paradigm shift approach in sample preparation for pre-clinical and clinical research. FPSE innovatively combines the benefits of solid phase extraction (SPE) (works under exhaustive extraction principle) and solid phase microextraction (works under equilibrium extraction principle) into a single sample preparation technology platform. FPSE utilizes a flexible and permeable fabric substrate, coated with high-performance sol-gel sorbents as the extraction media. This uniquely designed extraction medium is capable of extracting target analyte(s) directly from whole blood. Due to the special geometry of FPSE medium (flexible, flat, and permeable) and sponge-like porous architecture of sol-gel sorbents, rapid analyte mass transfer occurs between the bulk sample and the extraction medium, resulting in a near exhaustive extraction within a fraction of time required for other comparable sample preparation techniques.

FPSE is particularly suitable for analyzing target analytes e.g., drug residues, metabolites, biomarkers directly from whole blood without requiring any protein precipitation or other pre-extraction sample cleaning/manipulation.

After extracting the target analyte(s) directly from the whole blood sample, FPSE media is exposed to small volume of organic/organo-aqueous solvent for eluting the extracted analyte(s). Low viscosity of organic solvent, capillary force of the fabric support and sponge-like porous sol-gel network allows fast diffusion of organic solvent into the FPSE medium for quick and complete recovery of the extracted analyte(s). As a result, FPSE completely eliminates time consuming and error prone solvent evaporation and sample reconstitution step often considered as an integral part of solid phase extraction/liquid-liquid e work-flow. During the solvent mediated elution/back-extraction, any protein or matrix interferents adhered to the FPSE medium precipitates out and a final centrifugation of the resulting solution prior to injecting into the analytical instrument ensures clean particle-free highly concentrated target analyte(s).

Fabric phase sorptive extraction has already developed a large number of sol-gel sorbents specifically suitable for polar drugs/metabolites/biomarkers such as sol-gel polyethylene glycol, sol-gel chitosan, sol-gel Carbowax 20M, sol-gel polycaprolactone-dimethylsiloxane-caprolactone to name a few. These high-efficiency sorbents have been found equally effective for analytes with wide range of polarity. As a consequence, searching for the drug residues and their metabolites from whole blood in presence of numerous endogenous and exogenous interferents is no longer a wishful thinking but an achievable reality.

In the current talk, some new and fascinating data on bioanalytical sample preparation using FPSE and a comparison between FPSE and conventional sample preparation techniques will be presented.

Notes: