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EDITORIAL

Challenges and new directions in analytical sample preparation

Astrid Gjelstad · Stig Pedersen-Bjergaard

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Prior to injection of samples into a chromatographic system, some type of sample preparation is normally required. The purpose of the sample preparation is to (1) clean up the sample, (2) enrich target analytes to a concentration which can be measured, and (3) transfer target analytes to a medium which can be injected into the chromatographic system (compatibility tuning). Clean-up is mandatory to remove sample matrix components which can contaminate or deteriorate the chromatographic system. In addition, sample clean-up is required to remove matrix components which can be co-eluted with target analytes, and which can interfere with the detection. One example of the latter problem is ion suppression in liquid chromatography–mass spectrometry, where co-eluted matrix components can affect the ionization of the target analytes and cause suppression (or enhancement) of the analytical signals. Enrichment of target analytes is not always required, but for trace-level determination, typically for environmental applications, analyte enrichment is mandatory. Compatibility tuning is highly important for successful chromatography. For reversed-phase liquid chromatography, the samples should be injected preferably as aqueous samples or dissolved in the mobile phase (methanol/water or acetonitrile/water). On the other hand, for gas chromatography, the samples should ideally be dissolved in a non-polar organic solvent.

Popular sample preparation techniques today include liquid extraction, solid-phase extraction, and different precipitation or filtration procedures. These classic techniques have been used for many years, and are implemented in a large number of validated analytical methods which are in routine use worldwide. However, although most analytical problems can be solved with the classic sample preparation techniques, substantial research has been devoted to the development of new concepts and techniques. Especially during the last 15 years, a broad range of new techniques have been presented in the scientific literature, with solid-phase microextraction, stir-bar sorptive extraction, solid-phase extraction with molecularly imprinted polymers, microextraction in a packed syringe, liquid-phase microextraction, and electromembrane extraction as some examples. Several of these techniques have recently been commercially available, which is important for general implementation and acceptance. Development of new techniques has been justified by the need for more rapid, solvent-free, specific, and soft extraction methods, and for methods which can handle very small sample volumes.

Currently, the field of sample preparation is very active, and a large number of research articles have focused on sample preparation. The current collection of articles is intended to give a flavour of this research, and includes articles related to the use of functionalized magnetic nanoparticles, hydrophilic interaction liquid chromatography in solid-phase extraction, electromembrane extraction, continuous-flow pressurized hot water extraction, and thin-film microextraction. Hopefully, these articles will provide inspiration for further development of new sample preparation techniques.

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A. Gjelstad (✉) · S. Pedersen-Bjergaard
Department of Pharmaceutical Chemistry, School of Pharmacy, University of Oslo, P.O. 1068, Blindern, 0316 Oslo, Norway
e-mail: astrid.gjelstad@farmasi.uio.no

S. Pedersen-Bjergaard
e-mail: stig.pedersen-bjergaard@farmasi.uio.no

Astrid Gjelstad is Associate Professor of Pharmacy in the School of Pharmacy of the University of Oslo. Her current research interests are in the field of analytical microextraction technologies and analytical sampling, including development of hollow-fibre liquid-phase microextraction, electromembrane extraction, and new devices for dried blood spot sampling.

Stig Pedersen-Bjergaard is Professor of Pharmacy in the School of Pharmacy of the University of Oslo and Professor of Analytical Chemistry in the Department of Pharmacy of the University of Copenhagen. His current research interests are in the field of analytical microextraction technologies and analytical sampling, including development of hollow-fibre liquid-phase microextraction and electromembrane extraction.