K12 The Optimization of a Sol Solution for Its Use With Molecular Imprinting for the Extraction of Illicit Drugs

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After attending this presentation, attendees will learn the solidification process of a sol gel along with factors affecting gel solidification and network strength. The process surrounding the molecular imprinting of sol gels will also be shown, with preliminary data on the imprinted sol gel's uptake of the target drug molecule.

This presentation will impact the forensic science community by demonstrating how the use of a novel sol gel can be molecularly imprinted with illicit drugs to enhance the selectivity and extraction efficiency in comparison to current techniques due to its high stability, retention capacity, and affinity for the imprinted target molecule.

According to the 2009 National Survey on Drug Use and Health (NSDUH), over 20 million Americans, aged 12 and older, were said to be current users of illicit substances, an increase from 2008. With the rise in drug abuse, the frequency of forensic drug testing is becoming more prevalent. Drug testing can be performed on variety of biological specimens, such as urine, to determine the presence of any residual illicit substances and to conclude if the presence of such substances were the cause of criminal behavior. When testing for the presence of drugs, samples must undergo an extensive sample preparation process in order to pre-concentrate the analyte, as well as to minimize the detrimental effects of sample matrix interferences. Such procedures can prove to be a challenging task for many forensic toxicologists due to the complexity of biological specimens.

Solid phase extraction (SPE) is the most common technique for drug extraction and preparation, yielding high recoveries and clean extracts of the target drugs; however, SPE offers only generic selectivity, often extracting other matrix interferences, complicating instrumental identification and quantification. In order to improve extraction selectivity, molecularly imprinted polymers (MIPs) have been developed. Recently, studies have shown that the use of molecular imprinting for the extraction of illicit drugs yields better recoveries than SPE, as they display higher molecular recognition for the template molecule. It was also found that MIP provides an enhanced sensitivity with a more superior limit of detection than that of SPE. Furthermore, MIP has a higher ability for matrix reduction, removing a larger amount of background and interferences existing from biological matrices.

The polymer chosen to be molecularly imprinted for this research is a sol gel. Through the sol gel process, a silica based network is created which can and has been utilized for the production of ceramic or glass particles, surface bound coatings, and SPE cartridges. Sol gel chemistry has received an increased amount of attention in recent years due to its high thermal stability and increased intermolecular interactions between target analytes and itself. Another advantage is its high and adjustable porosity, which allows for high retention capacity of the extracted drug. Furthermore, sol gels are also very easy to prepare and can solidify at ambient temperatures. Other polymers that have been experimented with for the purpose of molecular imprinting produced swelling which causes a distortion of the cavities that are left behind after imprinting the target drug molecule. On the other hand, using a sol gel with molecular imprinting, allows for a higher selectivity than imprinting on other polymers because of the negligible swelling that sol gels produce.

An optimal sol gel was created by varying the various key ingredients. The ideal molar ratio of the participating ingredients was determined and the sol gel's ability to maintain its shape during supercritical fluid extraction (SFE) demonstrated strength and stability of the network. A scanning electron microscope (SEM) was used to view the gel's homogeneity and its porosity. This new optimal sol gel has a high porosity allowing for the enhancement of the gel's surface area, and thus, its retention capacity. Preliminary data will be provided demonstrating the molecular imprinting capability of the novel sol gel, as well as factors affecting gel solidification and network strength. This newly developed sol gel is highly stable and highly porous, making this an ideal candidate for molecular imprinting, and thus, a providing a promising future for the capability of drug extractions.

Sol Gel, Molecular Imprinting, Toxicology

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