Development and Application of Surfactant-mediated Methods for the Extraction and Analysis of Biological and Herbal Materials

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Abstract

In the first part of this thesis, the feasibility of employing aqueous non-ionic surfactant solutions as an alternative solvent system in accelerated solvent extraction (ASE) is demonstrated for the first time using the roots of American ginseng as model solid samples. When compared to the use of pure water or methanol, the presence of a common non-ionic surfactant (Triton X-100) in water at a concentration above its critical micelle concentration was shown to enhance the amount of pharmacologically active ingredients (ginsenosides) extracted from ginseng roots. The advantages of using aqueous non-surfactant solutions were also demonstrated by comparing extraction performances between ultrasonic-assisted extraction and ASE methods. Furthermore, the combination of ASE and cloud point extraction was shown to be a new and effective approach for the rapid sample preconcentration of herbal materials prior to analysis by high-performance liquid chromatography.

In the second part of this thesis, the cloud point phase separation phenomenon of a non-ionic surfactant, Triton X-100, was used for the extraction and preconcentration of several biological important molecules, i.e., porphyrin carboxylic acids and zinc protoporphyrin, in urine. The effectiveness of cloud point extraction was shown by investigating the effects of different extraction conditions on the extraction of various
urinary porphyrins. It was found that porphyrins could be successfully extracted under acidic medium, with the addition of ammonium sulfate for the induction of cloud point phase separation/preconcentration.

Furthermore, the addition of an anionic surfactant, SDS, as an additive in HPLC mobile phases was shown to be useful in minimizing sample preparation steps, such as protein removal, so that direct injection of the physiological samples in the chromatographic system is possible, and highly reproducible chromatographic peaks can be obtained. The cloud point extraction method with preconcentration using Triton X-100 followed by HPLC with a mobile phase containing SDS was developed for the fluorimetric determination of porphyrins in urine with detectability at the ng/L level.
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