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Separation of Ephedrines Using 1-Butyl-3-methylimidazolium-tetrafluoroborate Ionic Liquids as Eluent in High-performance Liquid Chromatography (HPLC)

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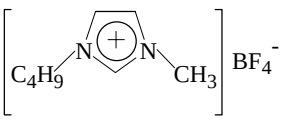
Abstract: A simple, effective HPLC method for separation of ephedrines was achieved by using 1-butyl-3-methylimidazolium-tetrafluoroborate ionic liquid solution (0.1% v/v) as eluent at pH 3.0. The involved mechanism may be due to that the imidazolium cations can effectively shield the silanol groups of alkylsilica surface, thereby decreasing band tailing and increasing the separation efficiency.

Keywords: Ionic liquid, ephedrine, HPLC.

Ionic liquids, as possible environmental benign solvent, have attracted increasing interests in many chemical aspects[1, 2, 3]. In general, an ionic liquid is a liquid that consists of only ions and has lower melting point than common ionic salts. The application of 1-alkyl-3-methylimidazolium ionic liquids to chromatographic separation was reported firstly by Yanes *et al.*[4], where ionic liquids were used as the running electrolytes in capillary electrophoresis for separation of polyphenols.

In this study, a simple and effective HPLC method was developed for the separation of ephedrines (norephedrine, ephedrine, pseudoephedrine, methylephedrine) in 17 min, using only 0.1% (v/v) 1-butyl-3-methylimidazolium-tetrafluoroborate (1-B-3-MI-TFB) solution (**Scheme 1**) as eluent, C_{18} column and UV detection.

Scheme 1



In comparison with the eluent containing only water (**Figure 1A**), the addition of 1-B-3-MI-TFB has the remarkable effects on the separation of ephedrines (**Figure 1B**), decreasing the retentions of all solutes, improving the resolution of solutes, and increasing the separation efficiency and symmetry of four chromatographic peaks.

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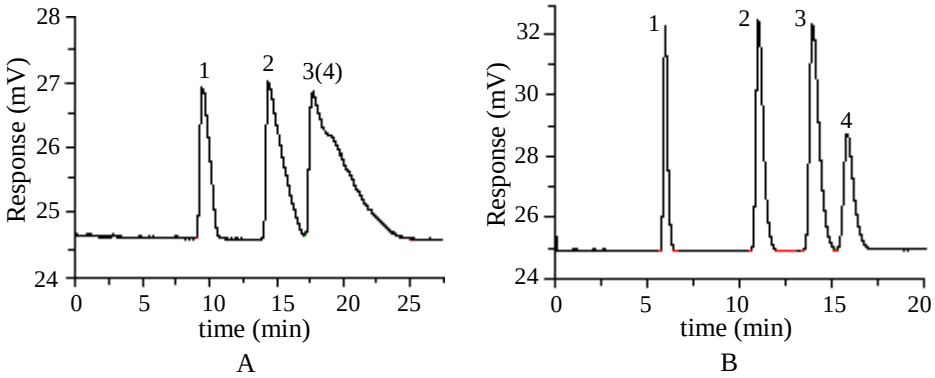
Figure 1 Chromatograms of ephedrines



Chromatographic conditions: column, Chromatorex ODS (5 μm) (100 mm×4.6 mm I.D.); eluent, water (A) or 0.1 % (v/v) 1-B-3-MI-TFB solution (B) at pH 3.0; flow-rate, 1 mL.min^{-1}; detection, UV at 252 nm; injection volume, 20 μL. Peaks: 1. norephedrine, 2. ephedrine, 3. pseudoephedrine, 4. methylephedrine.

The effects of 1-B-3-MI-TFB might be due to the competitive action between the positively charged imidazolium ion and the silanol groups of alkylsilica surface with polar group of analytes. Thus, the residual silanol groups can be effectively shielded and the separation is improved.

As for ephedrines, they are basic compounds with polar functional groups, and such compounds exhibit severe band tailing, band broadening and low plate numbers in HPLC analysis. Furthermore, conventional HPLC methods employ extensively aqueous-organic mobile phases[5, 6], which are volatile and harmful to the environment. The application of 1-B-3-MI-TFB ionic liquid to HPLC provides a more effective, feasible way for the separation of basic compounds with polar groups. The applications of ionic liquids for separation other compounds are in progress.

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