Imidazolium-based ionic liquid-type surfactant as pseudostationary phase in micellar electrokinetic chromatography of highly hydrophilic urinary nucleosides

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Abstract:

Ionic liquid (IL)-type surfactants have been shown to interact more strongly with polar compounds than traditionally used quaternary ammonium cationic surfactants. The aim of this study is to provide an alternative micellar electrokinetic chromatographic method (MEKC) for the analysis of urinary nucleosides in their ionic form at low surfactant concentration. This approach could overcome the use of high surfactant concentrations typically associated with the analysis of these highly hydrophilic metabolites as neutral species, which is frequently accompanied by high electric current, Joule heating and long analysis time. The investigated IL-type surfactant; 1-tetradecyl-3-methylimidazolium bromide (C14MImBr) is similar to the commonly employed cationic surfactant; tetradecyltrimethyl ammonium bromide (TTAB) but it provides a different separation selectivity. We employed C14MImBr micelles for the MEKC analysis of seven urinary nucleosides. The studied analytes possess a negative charge at pH 9.38 (exceptions are adenosine and cytidine which are neutral at this pH value). Borate imparts an additional negative charge to these compounds after complexation with the cis-diol functionality of the ribose unit, which in turn enables them to interact with the oppositely charged C14MImBr micelles via electrostatic (Coulomb) forces. The effect of the concentration of borate (the complexing, competing and buffering ion) on the effective electrophoretic mobilities and on the retention factors was investigated. The effective electrophoretic mobility data show that complexation between these nucleosides and borate occurs with high degree of complexation even at very low borate concentration (2.5 mmol L⁻¹ disodium tetraborate). In addition, we found that the retention factors are strongly dependent on the borate concentration being the highest when using the lowest borate concentration and they can be regulated by variation of either tetraborate concentration or the pH of the background electrolyte using only 20 mmol L⁻¹ C14MImBr. We confirmed also that the main mode of interaction between these analytes and the C14MImBr micelles is electrostatic interaction. Our experimental results reveal that the cationic surfactant C14MImBr exhibits superior selectivity and higher reproducibility relative to that of TTAB, which makes this surfactant a promising cationic surfactant for the MEKC separation of other hydrophilic polar analytes.

Keywords:

Micellar electrokinetic chromatography; Ionic liquid-type surfactant; Urinary nucleosides; Borate complexation; Ion-exchange interaction

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