A Thermoresponsive Polymer Based on Amino Acid Ionic Liquids as Extractant for Efficient Separation of Tocopherol Homologues

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Abstracts

Products with natural bioactivity are considered to be high added-value products. However, current separation methods of these products require large solvent consumption, and have low separation efficiency and significant energy expenditure. To address these issues, we have proposed a new method of using soluble polymers as an extractantant (SPE) for the liquid-liquid extraction of α-tocopherol from tocopherol homologues. The thermoresponsive SPEs comprising an amino acid ionic liquid (AAIL) have been synthesized via reversible addition-fragmentation chain transfer (RAFT) solution copolymerization of AAIL and N-isopropylacrylamide

(NIPAM) at 65 °C using O-ethyl-S-(1-carboxy)methyl dithiocarbonate as a RAFT chain transfer agent. The SPE samples had molecular weights between 6.75-10.2 kg/mol, molecular weight distributions between 1.10-1.25, and AAIL molar fractions between 0.64-0.90. Effects of chain length and copolymer composition on separation efficiency were investigated. A distribution coefficient of 8.92 and a selectivity coefficient of δ-tocopherol to α-tocopherol of 13.8 have been achieved with the SPEs. The distribution and selectivity coefficients were found to increase with decreasing chain length of the SPE and increasing the molar ratio of NIPAM in the SPE. By lowering the temperature of the extract liquor, the SPEs were easily and fully separated from the tocopherol homologues, resulting in more than 93% recovery of tocopherols. The SPEs can be reused for multiple extraction cycles without any change to the distribution or selectivity coefficients of tocopherol. These thermoresponsive polymeric ionic liquid based SPEs turn to have high separation efficiency and low energy consumption in the liquid-liquid extraction.

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