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Selective separation of vanillic acid from other lignin derived monomers using centrifugal partition chromatography

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PURPOSE OF THE ABSTRACT

Lignin depolymerization processes have been developed to produce high value monomeric and oligomeric aromatic compounds to replace current fossil-based aromatics in the formulation of new goods and commodities. However, a complex mixture of aromatic compounds is formed after lignin depolymerization, while subsequent downstream processing still presents technical bottlenecks in their separation and purification. In this context, novel downstream technologies capable of overcoming those issues and simultaneously integrate separation and purification steps are required. In this work, an aqueous biphasic system (ABS) coupled with centrifugal partition chromatography (CPC) was applied for the separation of vanillic acid from other four lignin derived monomers, namely vanillin, syringaldehyde, acetovanillone and p-hydroxybenzaldehyde, regularly stemming from lignin depolymerization treatments. The ABS formed by polyethylene glycol (PEG) and sodium polyacrylate (NaPA) with addition of electrolytes (inorganic salts or ionic liquids) was selected to accomplish this separation. The influence of electrolytes and medium pH on the partition of those aromatic compounds was first studied and discussed. The obtained data revealed that ionic liquids (e.g. 1-ethyl-3-methylimidazolium dicyanamide ? [C2C1im][N(CN)2]) are a better option to enable separation in CPC, while medium pH influences the partition coefficients (K) of lignin monomers, particularly vanillic acid's, leading to its selective separation. The double deprotonated form of vanillic acid at pH 12 provides a distinct interaction between the top (PEG-rich) and bottom (NaPA-rich) phases of the ABS when compared to remaining lignin monomers, which only present a single deprotonation form at alkaline environments. Under optimal conditions, i.e, PEG 8000-NaPA 8000-[C2C1im][N(CN)2] ABS at pH 12 and CPC flow rate of 0.7 mL·min-1, a vanillic acid-rich fraction was obtained. Studies of ABS phase-forming components recycling indicate that the combined use of ultrafiltration (UF) and solid phase extraction (SPE) could be successfully used in the isolation of vanillic acid with 96% purity.

FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

Lignin | Aromatic monomers | Aqueous biphasic systems | Centrifugal partition chromatography

BIBLIOGRAPHY