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Preparative chromatographic separation of polyphenols from black chokeberry and sea buckthorn with macroporous resins

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The rising global awareness of health and nutrition has driven a significant increase in demand for functional foods that offer bioactive benefits. Polyphenols have gained popularity due to their antioxidant, anticancer, neuroprotective, and antidiabetic properties. This study investigates black chokeberry and sea buckthorn, fruits rich in these compounds but currently underutilized due to their astringency and acidity. To address this, we developed a systematic approach for the extraction and purification of these high-value compounds.

Initial experiments focused on preparing ethanol extracts and identifying primary bioactive compounds: seven compounds in black chokeberry and four in sea buckthorn. To optimize purification, a comprehensive screening of 26 adsorbents was conducted. Based on kinetic and adsorption isotherm experiments, the three most efficient resins—PAD600, FPX66, and XAD1180N—were selected for preparative column chromatography (d = 1 cm, L = 10 cm). Separations were performed using a controlled step gradient of ethanol to isolate compounds based on their relative polarities.

Results demonstrated that PAD600 was the most effective for recovering phenolic acids from black chokeberry. Conversely, XAD1180N proved superior for anthocyanin separation, achieving a 62% yield of cyanidin 3-glucoside in the 20% ethanol fraction, while also excelling in the isolation of the less polar rutin and quercetin 3-glucoside. In sea buckthorn separation, the highly polar vitamin C eluted probably primarily during the initial sample loading. Medium-polarity quercetin and isorhamnetin glycosides were concentrated in the 20% ethanol fraction, with recovery yields increasing in the order of PAD600 < FPX66 < XAD1180N.

These findings provide a systematic framework for the selective isolation of high-purity polyphenols, offering a viable pathway for transforming underutilized agricultural products into

valuable ingredients for the nutraceutical industry. Furthermore, this approach supports the circular economy by repurposing industrial waste into high-value commodities, thereby increasing crop profitability while making their delivering potent health benefits in a palatable, concentrated format.

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