

Potential application of green extracts rich in phenolics for innovative functional foods: Natural deep eutectic solvents as medium for isolation of biocompounds from berries



Mila Č. Lazović¹, Marko D. Jović¹, Ivica Z. Dimkić², Dušanka M. Milojković Opsenica³,
Petar M. Ristivojević³, Jelena Đ. Trifković³

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¹Innovative Centre of the Faculty of Chemistry, Belgrade, Serbia
²University of Belgrade – Faculty of Biology, Belgrade, Serbia
³University of Belgrade – Faculty of Chemistry, Belgrade, Serbia



INTRODUCTION

- Natural Deep Eutectic Solvents (NADES) are novel and promising solvents for green extraction of phytochemicals from food and agricultural products. NADES are made of natural origin compounds that are connected via hydrogen bond and have unique tunable properties¹.
- Numerous studies investigated the extraction of bioactive compounds using NADES resulted in better extraction efficiency compared to conventional solvents, suggesting large potential of these solvents^{2,3}.
- Low-toxicity, natural origin and affordability of NADES-based extracts enables their application as a preservative in the food industry or functional ingredient of food supplements.
- The aim of this study** was to develop an efficient eco-friendly method for the extraction of phenolic compounds from berries, blueberry, chokeberry and black goji berry, using NADES.

METHODS

Extraction efficiency of applied NADES was investigated through three different approaches:

- chromatographic, through high-performance thin layer chromatography (HPTLC) fingerprint analysis, ultra-high-performance liquid chromatography with a diode array detector and a triple-quadrupole mass spectrometer (UHPLC-DAD-MS/MS) target analysis and bioautography;
- spectroscopic, through quality control parameters, total phenolic content (TPC), total flavonoid content (TFC), total anthocyanin content (TAC) and radical scavenging activity (RSA);
- microbiological, through well diffusion method and minimum inhibitory concentration (MIC).

RESULTS

- In this study, 36 NADES mixtures, prepared from primary plant metabolites, were tested as green alternatives for extraction of phenolics from three berries. Different hydrogen-bond acceptors (HBA), such as choline chloride, L-proline, L-glycine, and L-lysine were mixed with various hydrogen-bond donors (HBD), four organic acids, two sugars, glycerol and urea, at various molar ratios for NADES preparation.
- Guided by the fact that extraction efficiency depends on polarity, viscosity and dissolving ability of solvents⁴, the influence of HBA, HBD and water content were investigated. Methanol, as conventional solvent, was used as contrastive solvent.

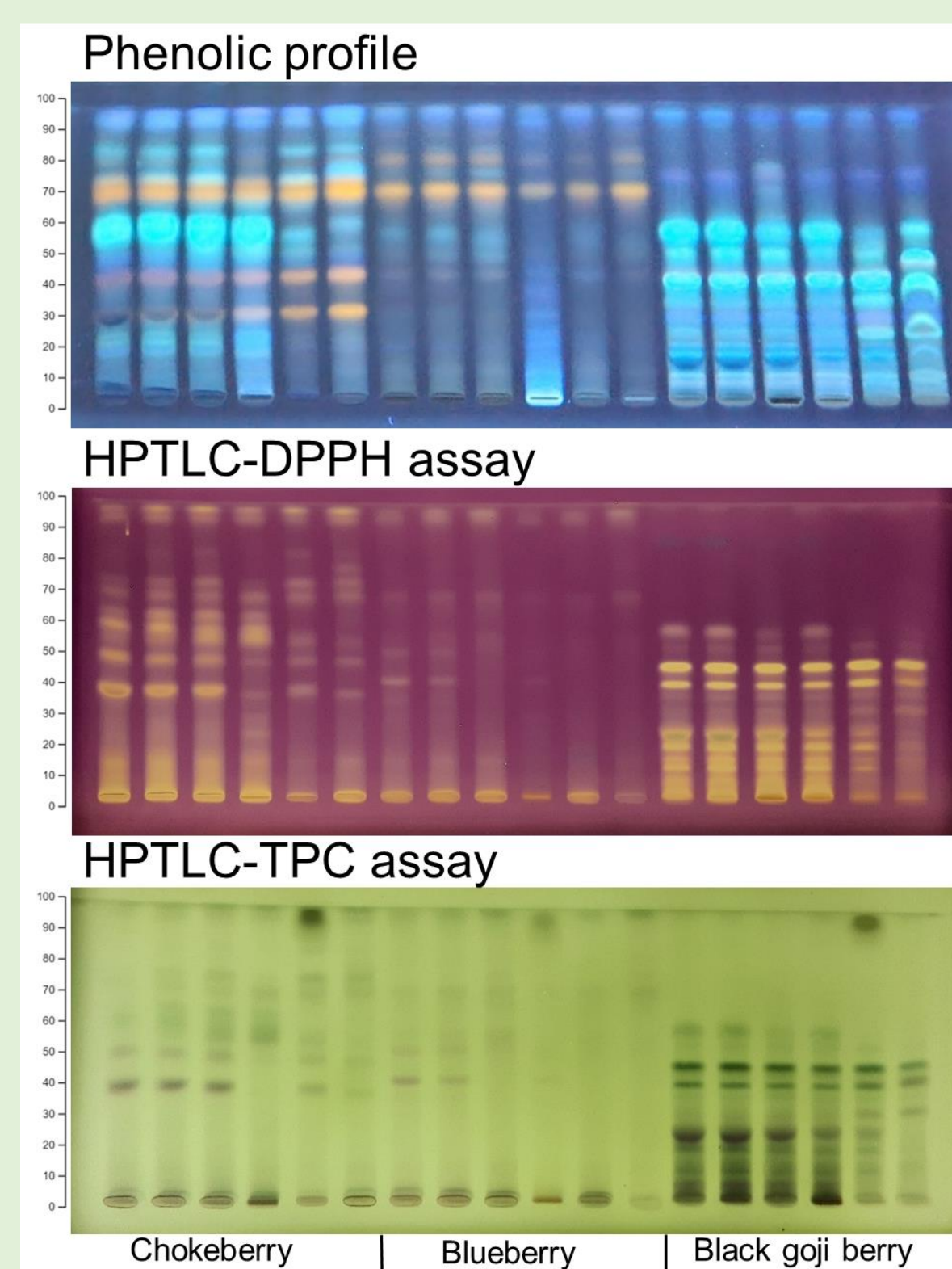


Fig. 1 HPTLC- antioxidative assays

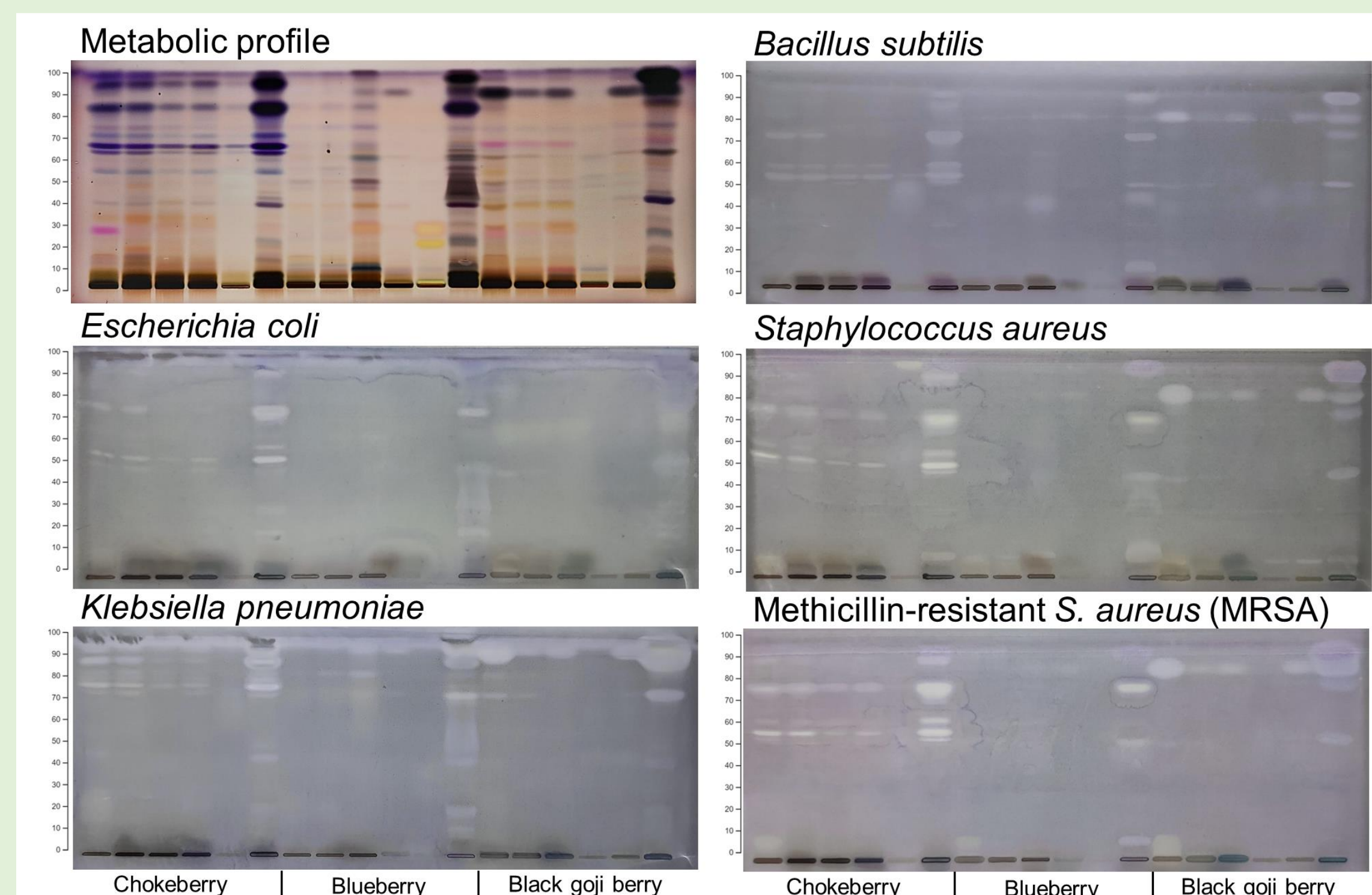


Fig. 2 HPTLC- direct bioautography

CONCLUSION

- Choline chloride-based NADES in combination with malic acid, glycerol or urea showed as most efficient. All groups of studied NADES showed various extraction capabilities for phenolic compounds based on chromatographic evaluation and spectrophotometric tests.
- These results indicate great power of NADES solvents towards selective extraction of phenolics and shows that NADES are designer solvents. Appropriate selection of components for NADES preparation can result in selective extraction of specific phenolic compounds.
- Great antioxidative and antimicrobial activity of studied extracts along with natural origin of NADES components, enables NADES extracts a significant advantage for application as functional food or food preservatives or food supplements and gives the opportunity for the creation of “green-labeled” products.

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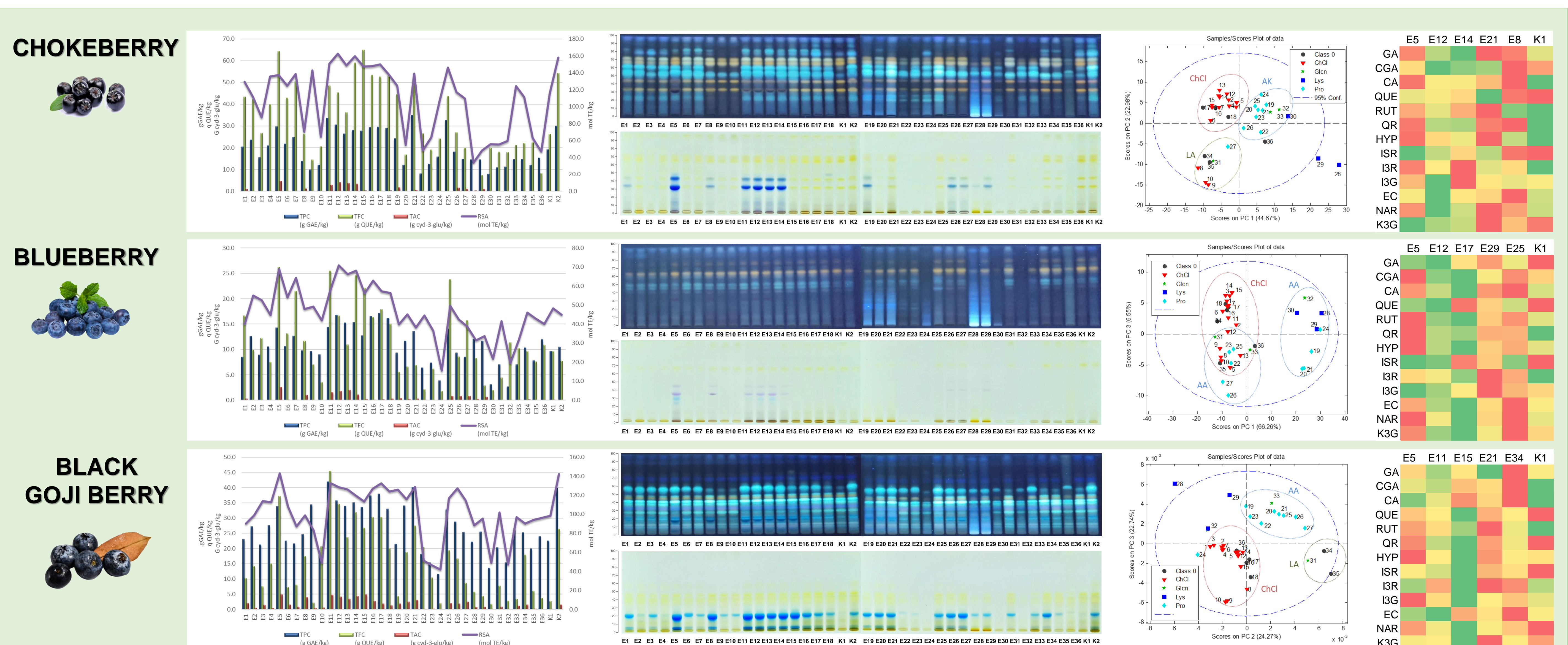


Fig. 3 Spectrophotometric assays, HPTLC profiles, Principal Component Analysis and heat maps of quantified phenolic compounds