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Comparative Spectroscopic Analysis of Bee Propolis: NIR, FT-IR, FT-Raman and ¹H NMR.

Focus on Provenance and Antioxidative Correlation

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Background

Propolis is a polyphenol-rich, resinous substance produced by honey bees. It is widely recognized for its antioxidative activity, mainly attributed to its high content of aromatic polyphenols.

Aim

To compare the chemical composition and antioxidative activity of propolis from Australia, Denmark, and Norway using untargeted spectroscopic methods, and to predict radical scavenging activity (RSA) using multivariate models.

Experimental

Propolis samples (N = 53) from Australia (8), Denmark (38), and Norway (7) were analyzed using IR, Raman, and NIR spectroscopy on raw material, and ¹H NMR on chloroform extracts. The latter is not shown in this poster. Radical scavenging activity (RSA) was measured using a colorimetric assay. Data were evaluated by Principal Component Analysis (PCA), correlation analysis, and Partial Least Squares (PLS) regression to explore composition and predict RSA.

Results

PCA showed Danish and Norwegian samples contained more aromatic compounds, while Australian samples had higher levels of carbohydrates and terpenoids. RSA was significantly lower in Australian samples ($p < 0.001$). NIR-based PLS models predicted RSA with the highest accuracy ($R^2 = 0.75$, RMSECV = 6.66%).

Conclusion

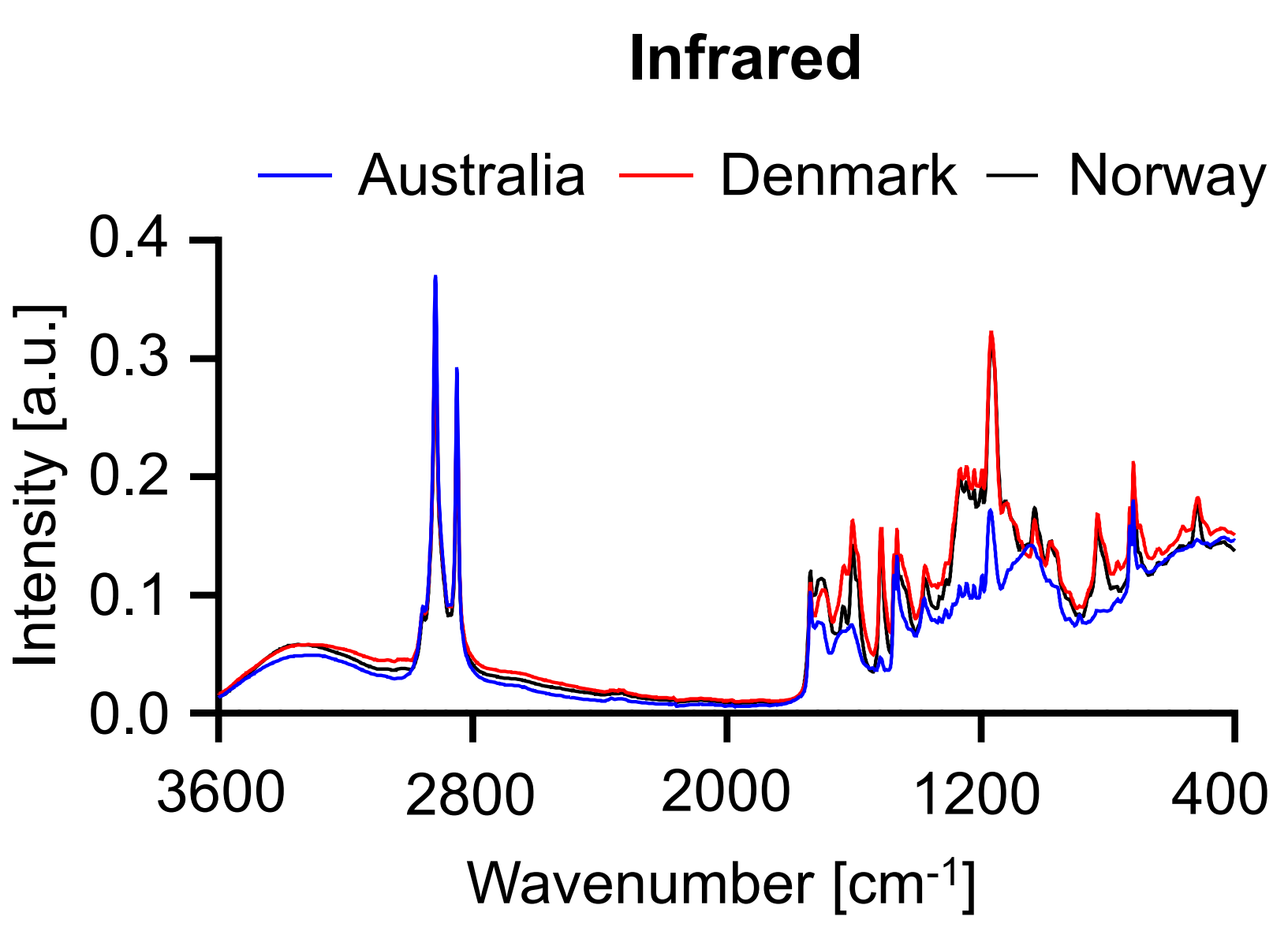
Untargeted spectroscopic methods effectively profiled propolis composition and predicted antioxidative activity. Scandinavian propolis showed higher RSA, likely due to increased aromatic polyphenol content. NIR spectroscopy proved most accurate for RSA prediction.

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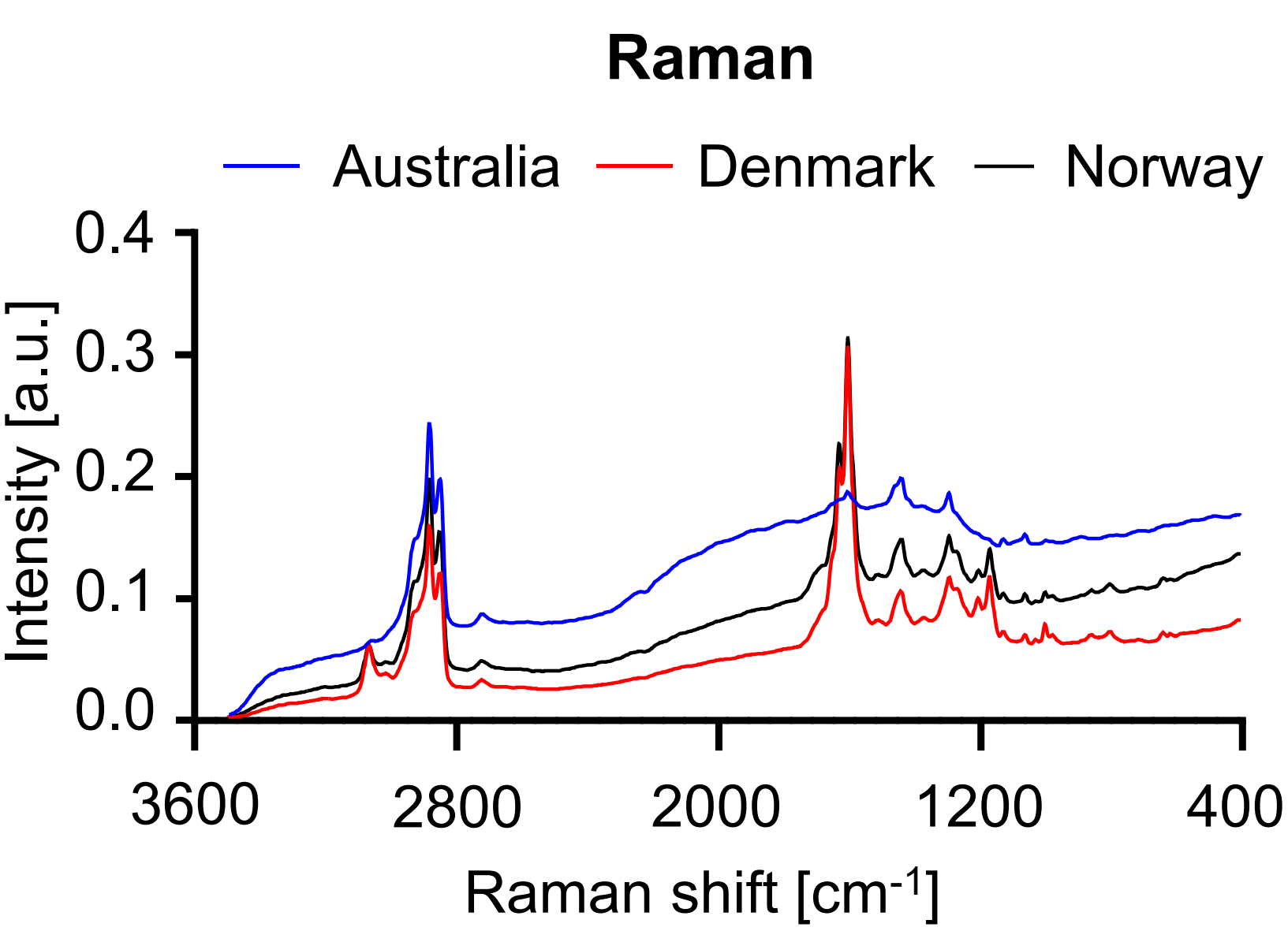


Step 1: Analyse propolis samples using spectroscopy

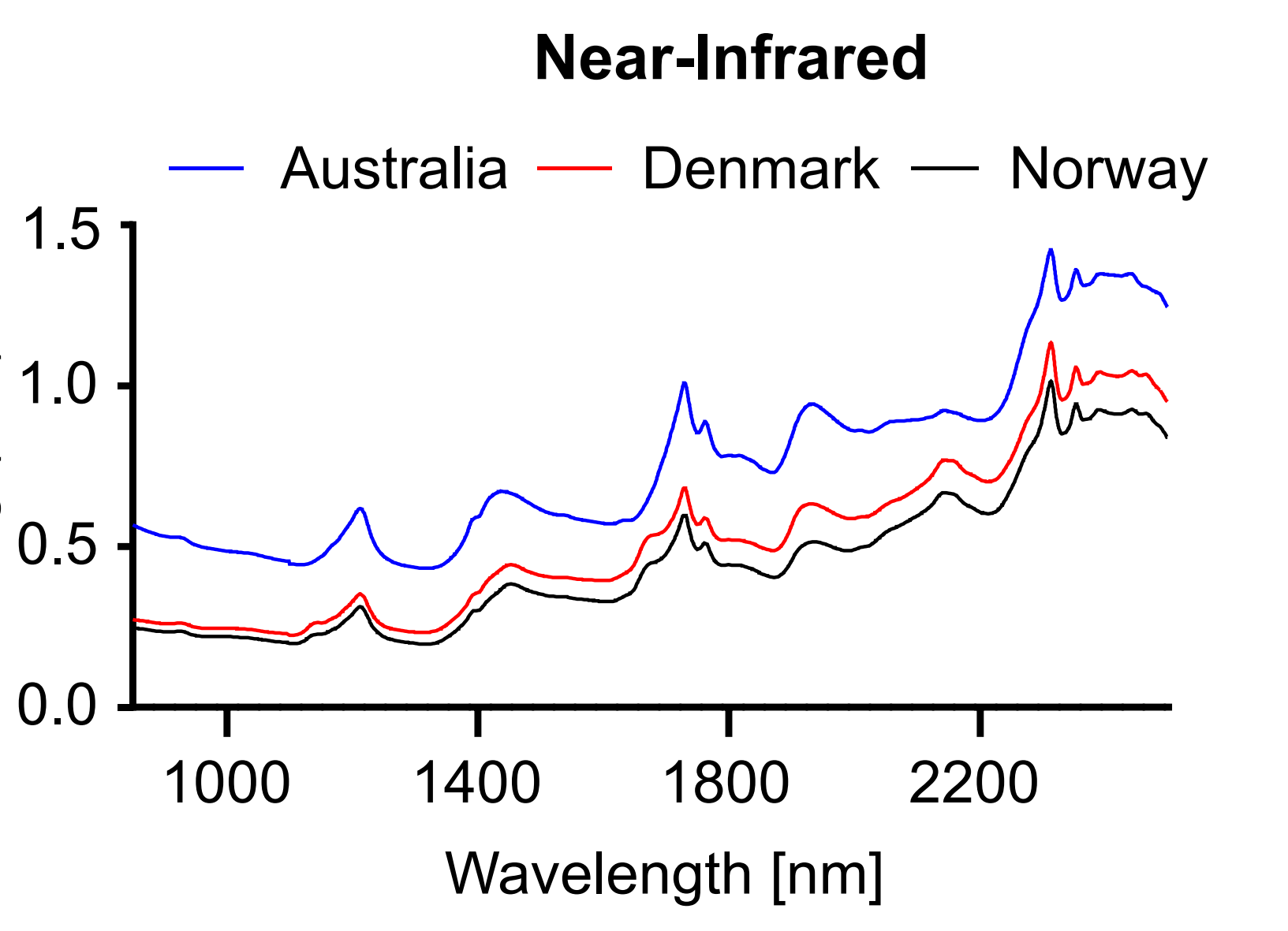
Infrared



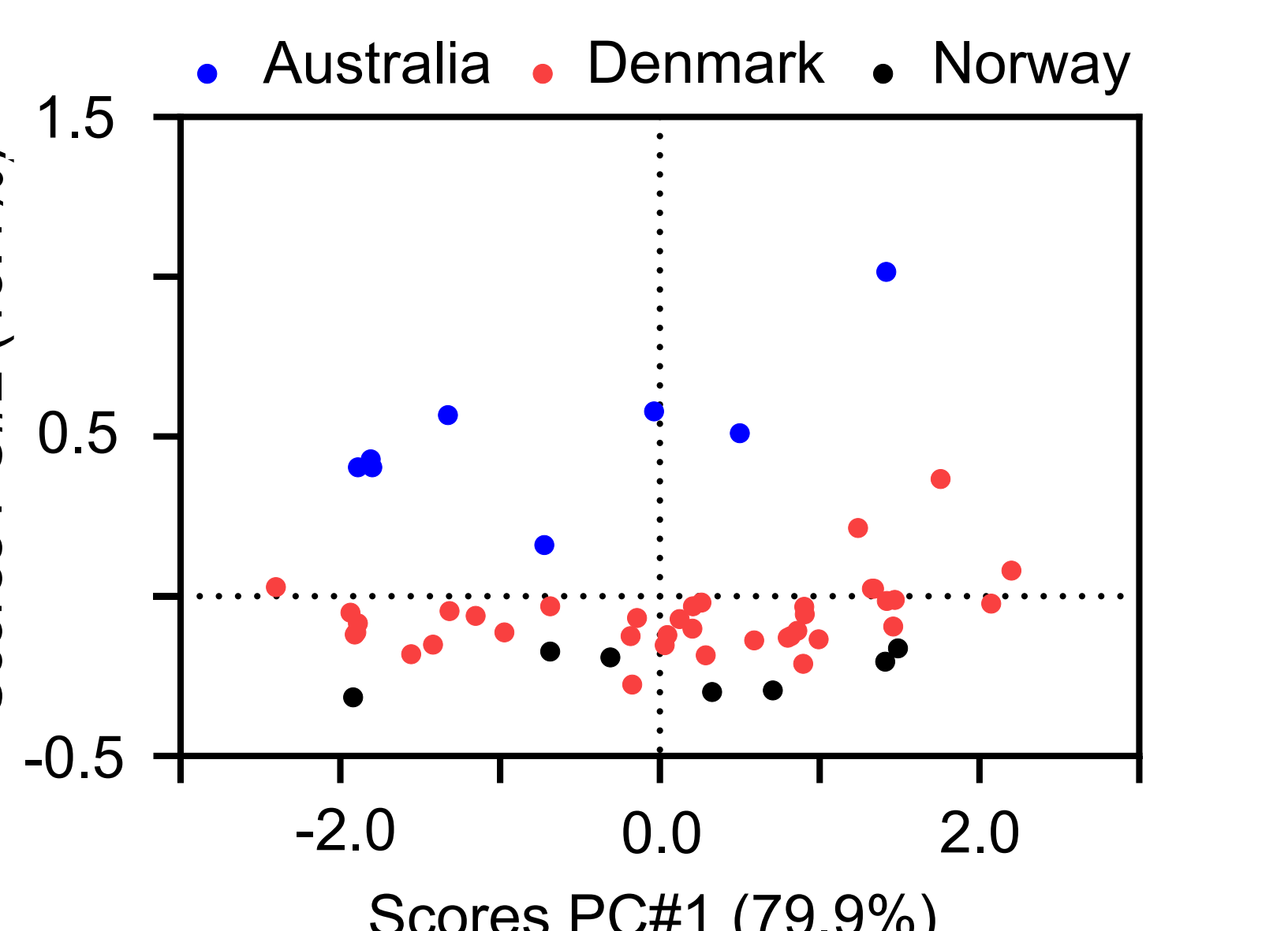
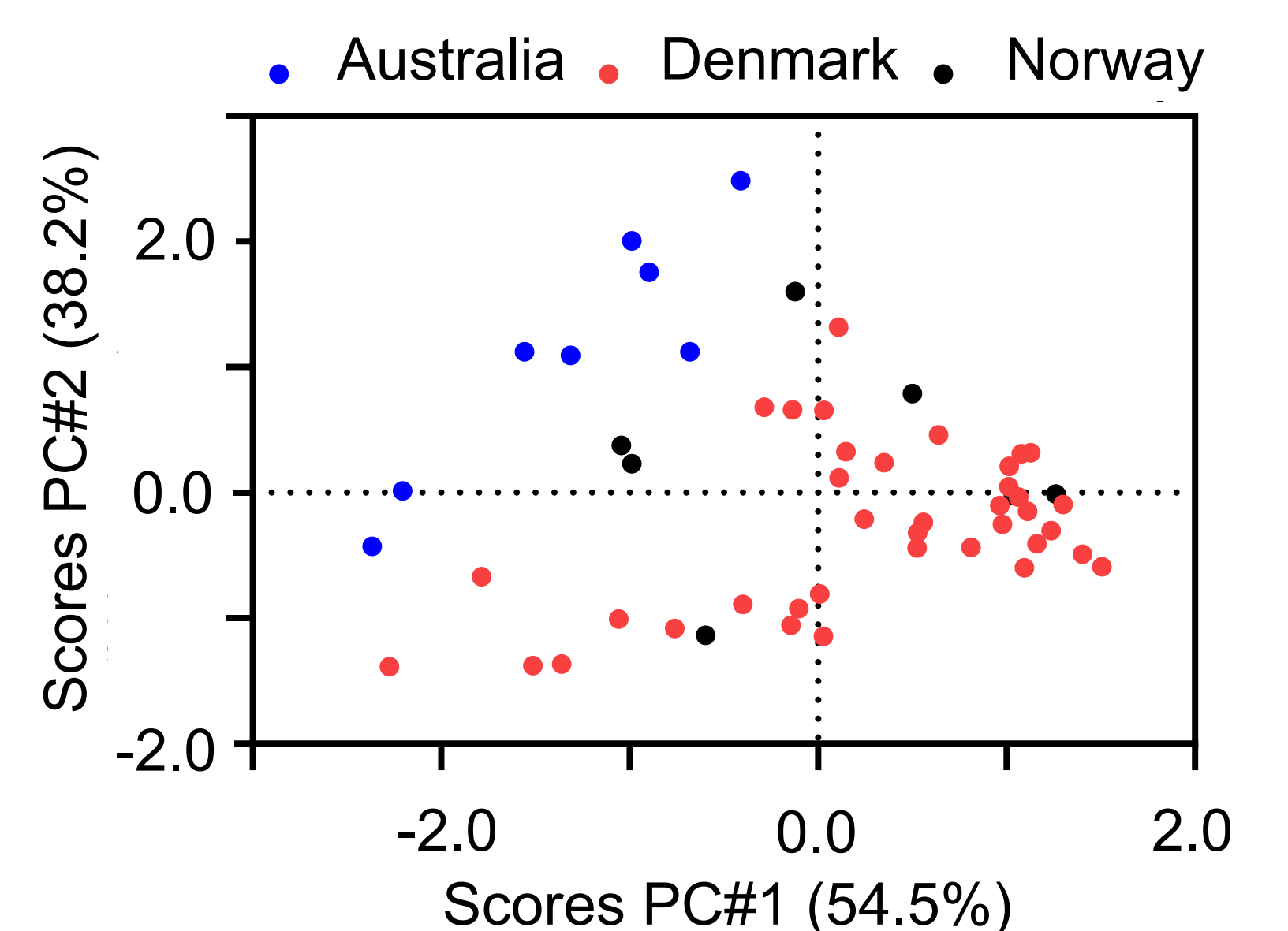
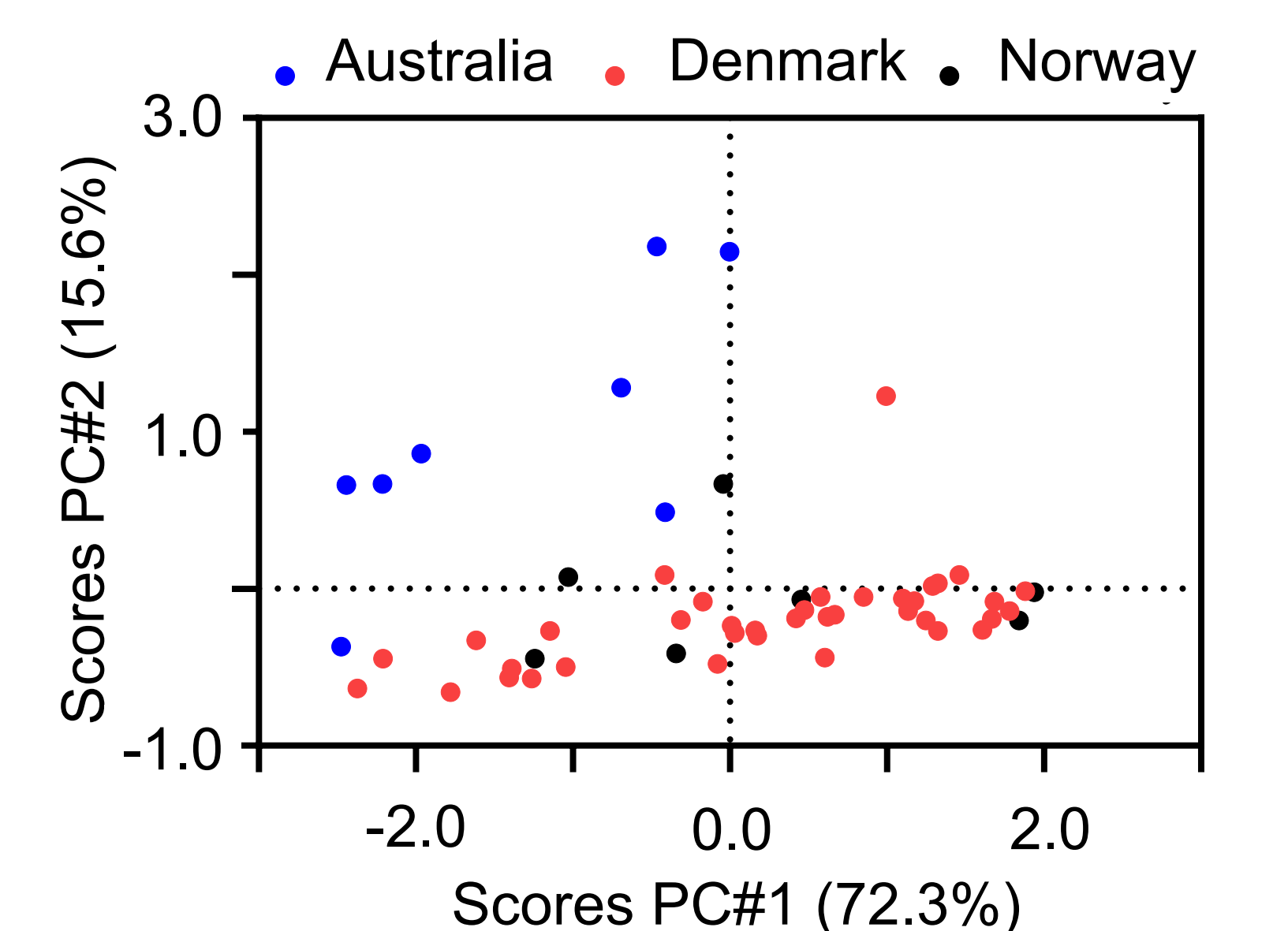
Raman

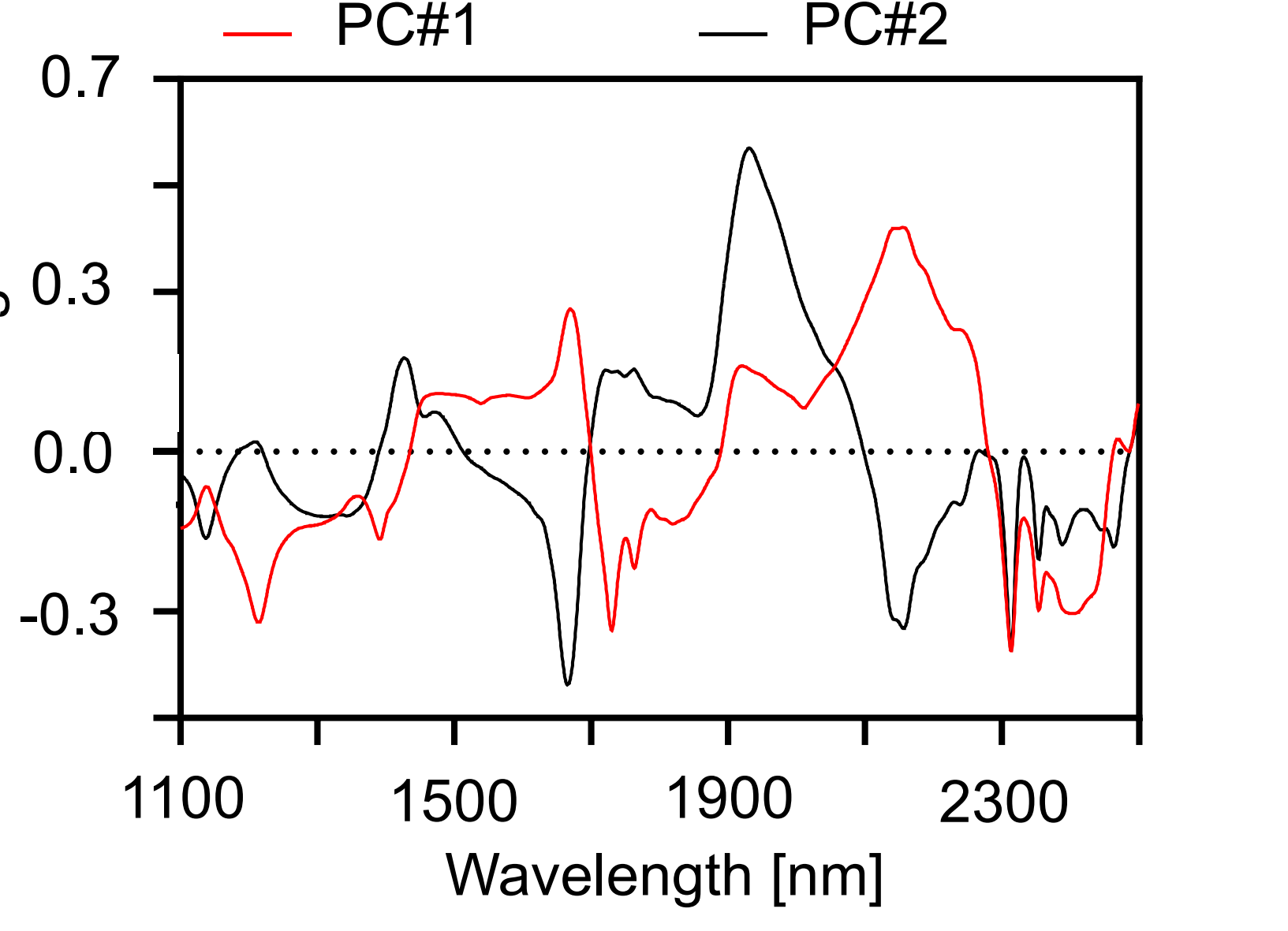
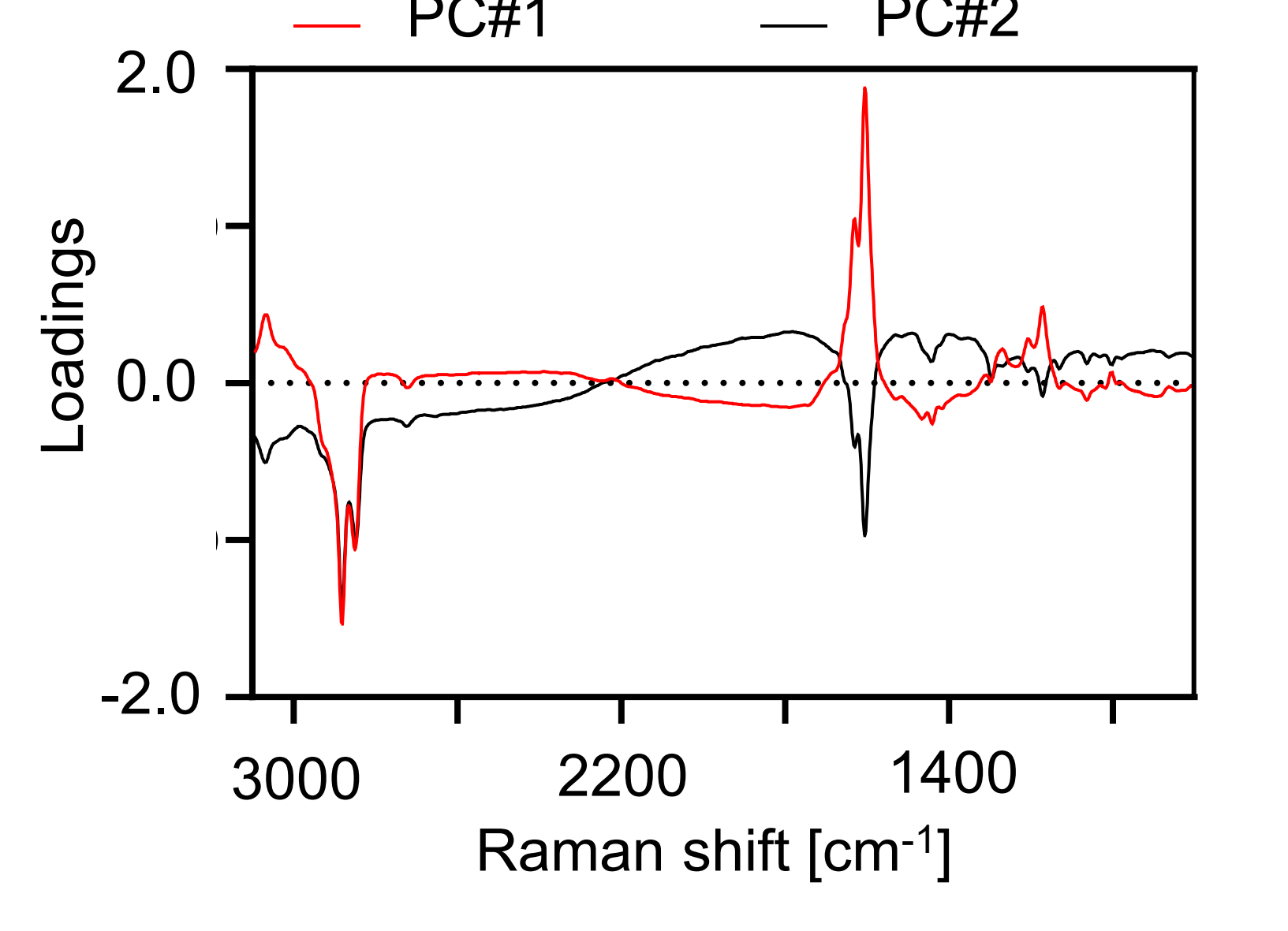
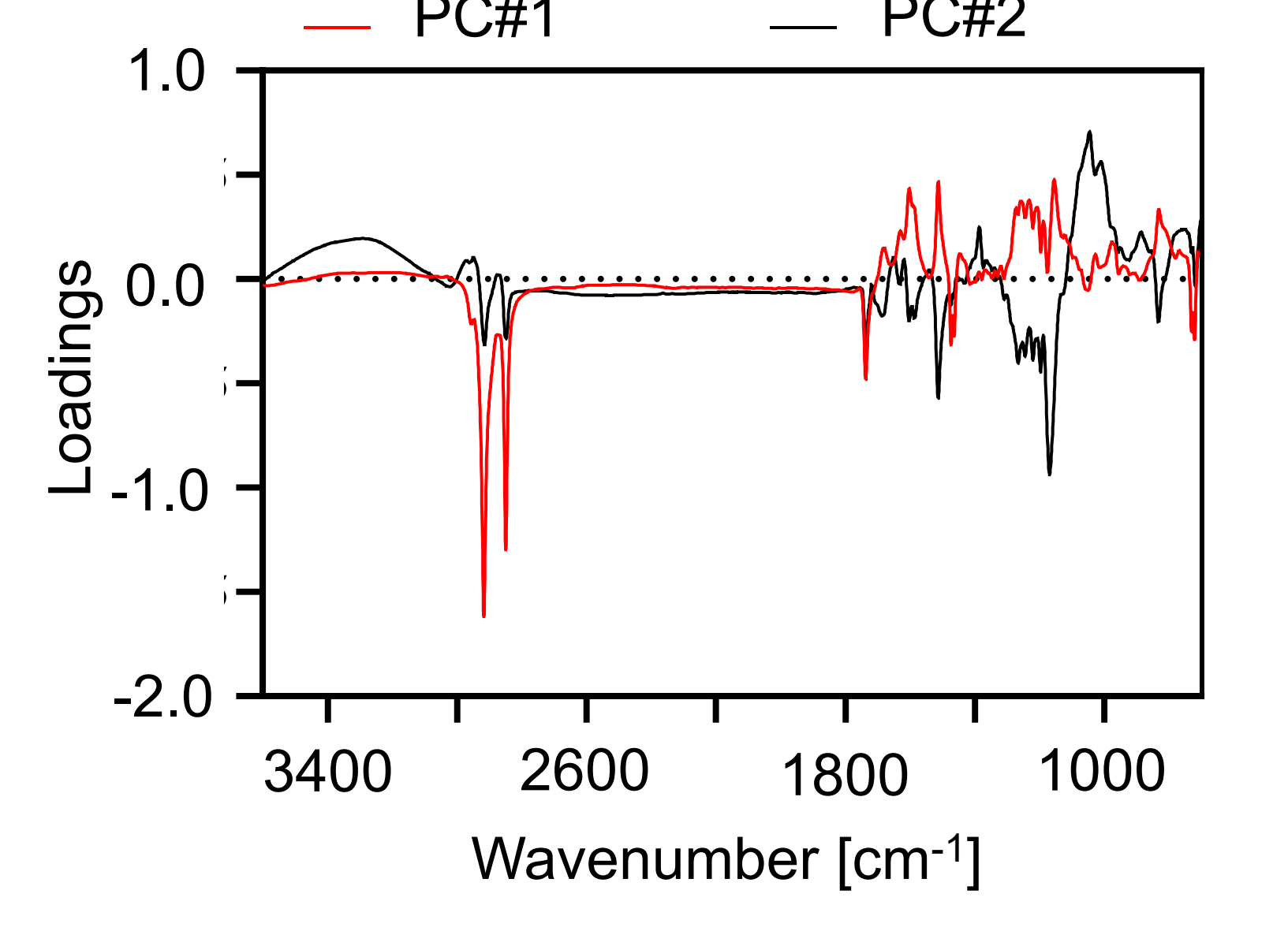


Near-Infrared

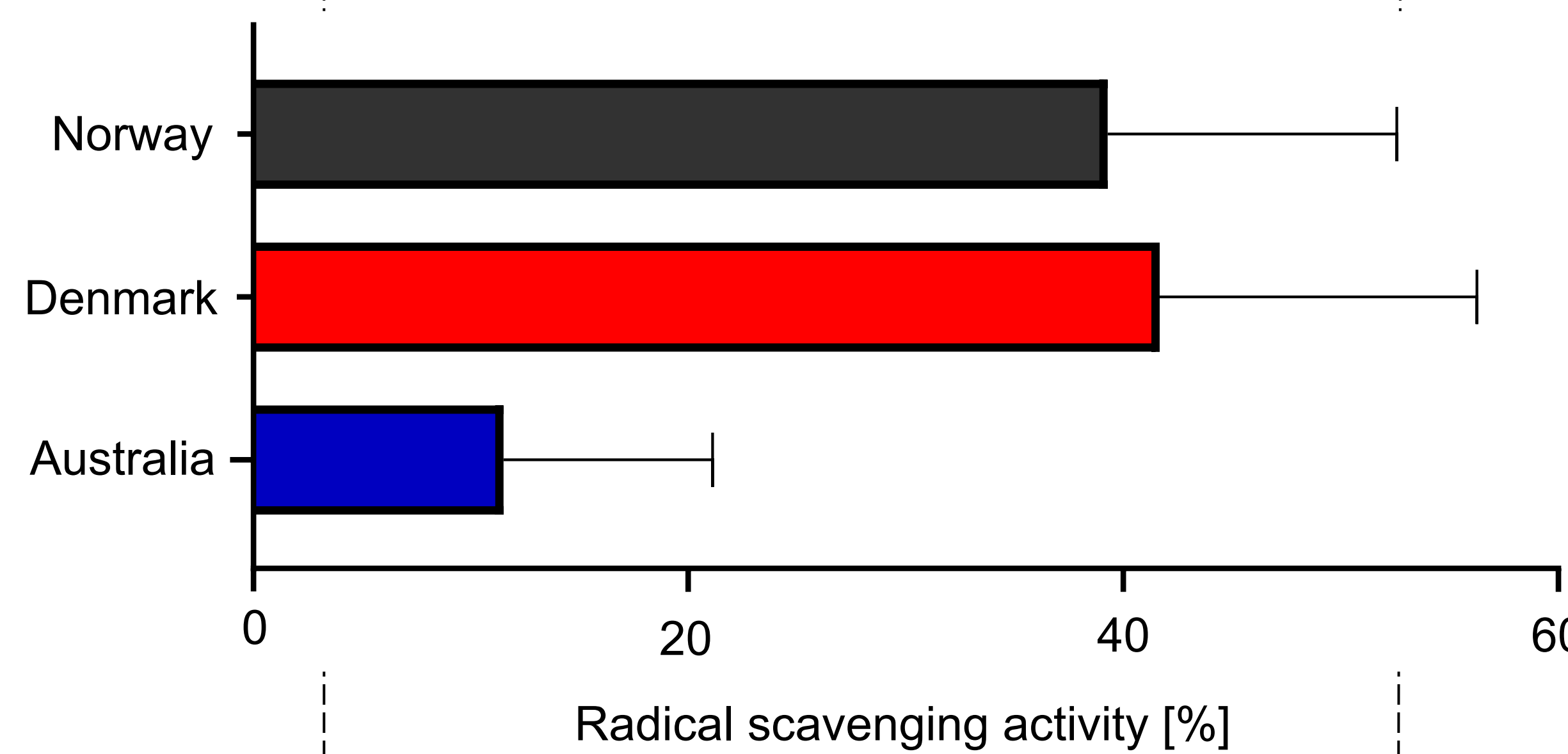


Step 2: Compare chemical composition using PCA





Step 3: Measure radical scavenging activity of propolis samples



Step 4: Predict radical scavenging activity based on spectroscopic data

