

Tracing down of honeys from different areas in Finland utilizing combination of NMR and mineral analysis

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Foto: Virpi Aaltonen, SML

Introduction

Honey is one of the most common sources of food frauds. Analytical tools are needed to recognize the fraudulent adulterations. Here we monitored organic and inorganic compounds in Finnish honeys and monitored them according to their origin.

Materials and methods

53 honey samples were analyzed with nuclear magnetic resonance (NMR) spectroscopy and X-ray fluorescence (XRF). NMR is an excellent method to compare organic compounds from similar samples – even visually as shown in figure 1. Results from selected 5 NMR peaks and 19 minerals were monitored with principal component analysis (PCA, LatentX2.13) to monitor differences according to their origin.

Conclusions

Honeys from different areas vary based on amounts their minor organic compounds and minerals, which can be utilized in tracing original of honey and detecting food frauds. NMR and XRF can be utilized for these analysis.

Results

Honey is mostly fructose, glucose, water, other sugars and several hundreds of other organic compounds on mg/kg level. Most common minerals were potassium (~850 mg/kg), chloride (~140 mg/kg), calcium (~50 mg/kg), and phosphorus (~40 mg/kg).

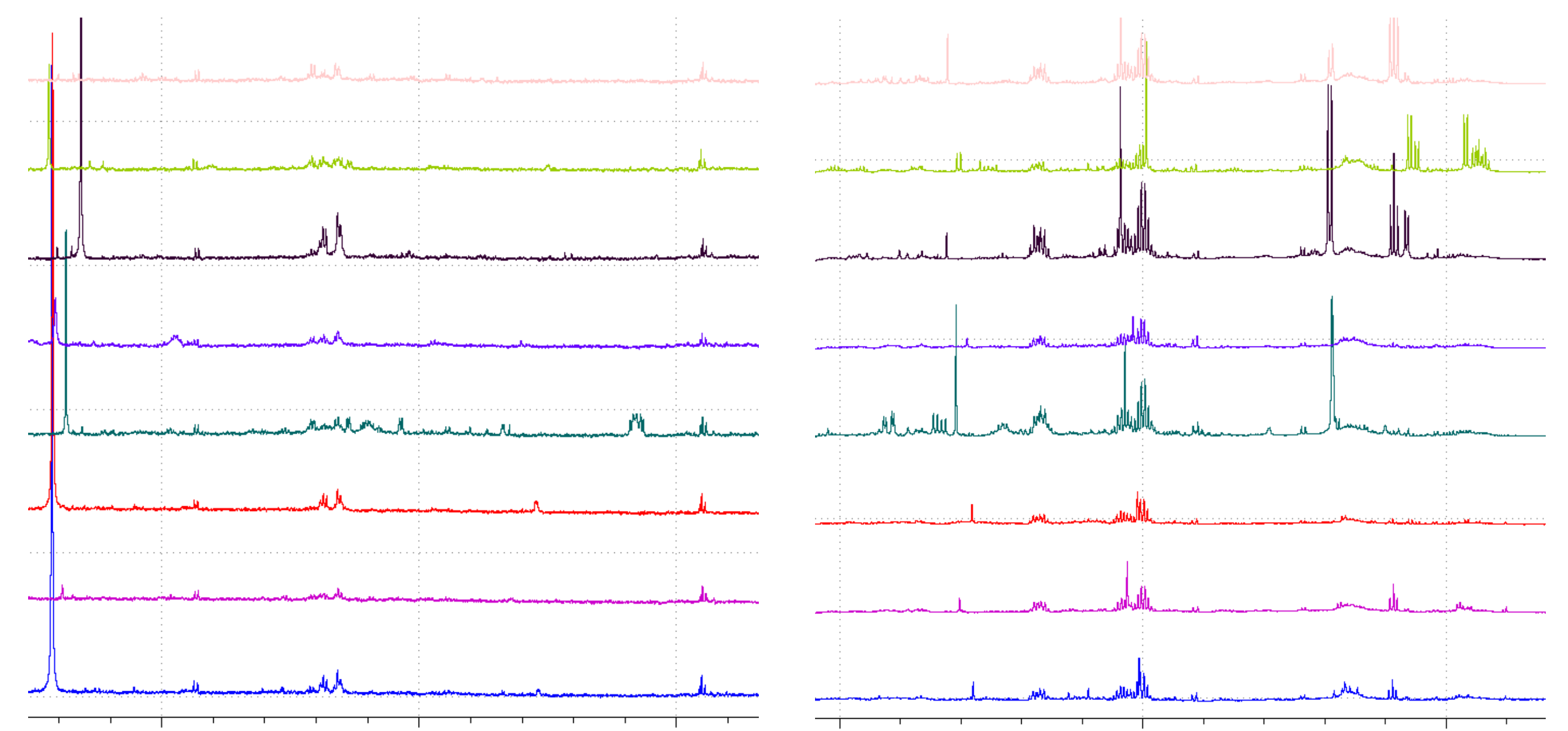


Figure 1. ¹H NMR spectra on selected honeys showing aromatic region (6-8 ppm) and organic/amino acid region (1-3 ppm). The three spectra at the bottom are from the same producer from different years, whereas the upper five spectra are randomly selected honeys from different producers showing remarkable differences.

With the combined results from NMR spectra and amounts of the minerals, the data was characteristic for different producers. Also, some regional characteristic could be found (figure 2). Honeys from Lapland were distinctive based on their mineral composition, especially Rb, Cl, K and S.

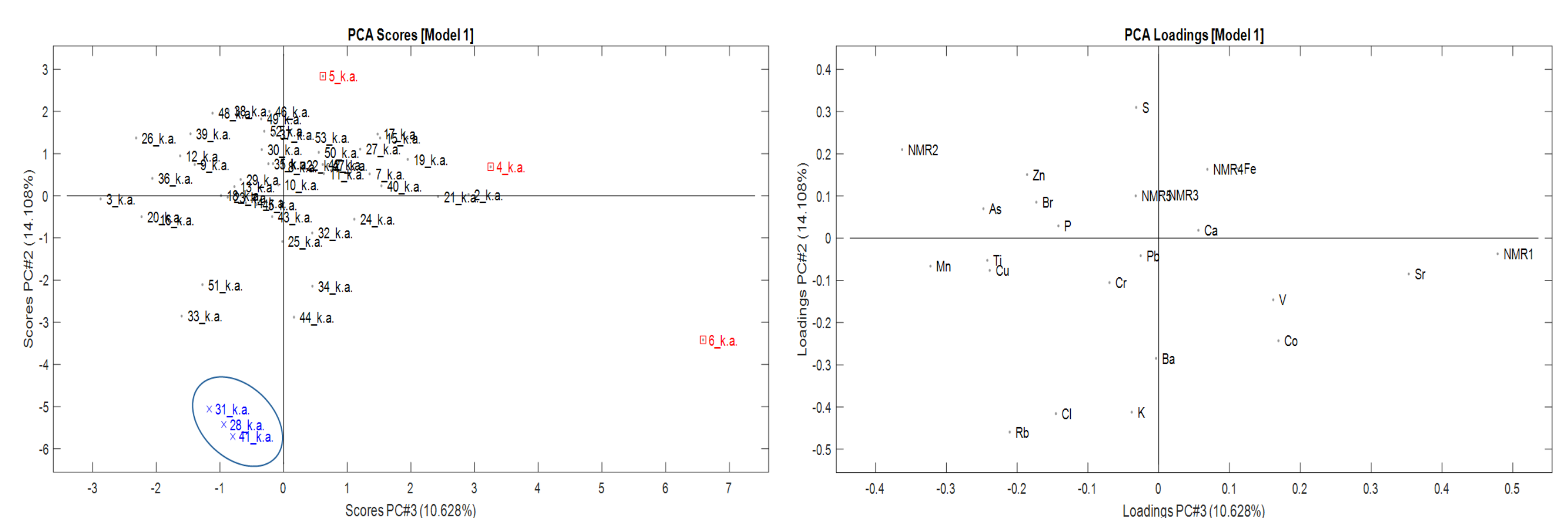


Figure 2. PCA scores plot and its loadings plot for 53 honey samples based on selected 5 NMR peaks and 19 minerals. Biggest variation according to their origin was related to PC2 and 3. Honeys from Lapland are marked in blue and three foreign samples (from Latvia, Crete and Chile) are marked in red.