

Abstract

Application of near infrared spectroscopy for determining the geographical origin of Indonesian nutmeg oils

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Introduction

Application of NIR spectroscopy combined with chemometric methods is a relatively new approach to determine the geographic origin of nutmeg oil. Four islands in Indonesia (Nord Sulawesi, Siau, Sanger and Maluku) are producers of nutmeg. The objective of this study was to evaluate near infrared spectroscopy (NIRS) for the determination of the geographic origin of nutmeg oil. The geographic origin induces changes in the oil composition.

Materials and methods

FT-NIR spectra were recorded with a Nicolet Antaris spectrometer interfaced to a personal computer. Oil samples were filled into a 4 mm pathlength tube directly sampled from the bottle without any chemical treatment. All the spectra were computed at 4 cm^{-1} resolution between 4500 cm^{-1} and 10000 cm^{-1} , using the software result integration 2.1 (Thermo Nicolet). Co-addition of symmetrical interferograms on 10 scans was performed for each spectrum. A reference spectrum was recorded before each sample measurement on an empty tube. Nutmeg oil samples (108) provided from four Indonesian islands were analysed. For some samples, the maturity of the nutmeg was known.

Results and discussion

Nutmeg contains 5–15% of essential oils. The mean composition is complex, with about 80% of monoterpenes (alpha-pinene, sabinene, beta-pinene, gamma-terpinene, camphene), 5% of

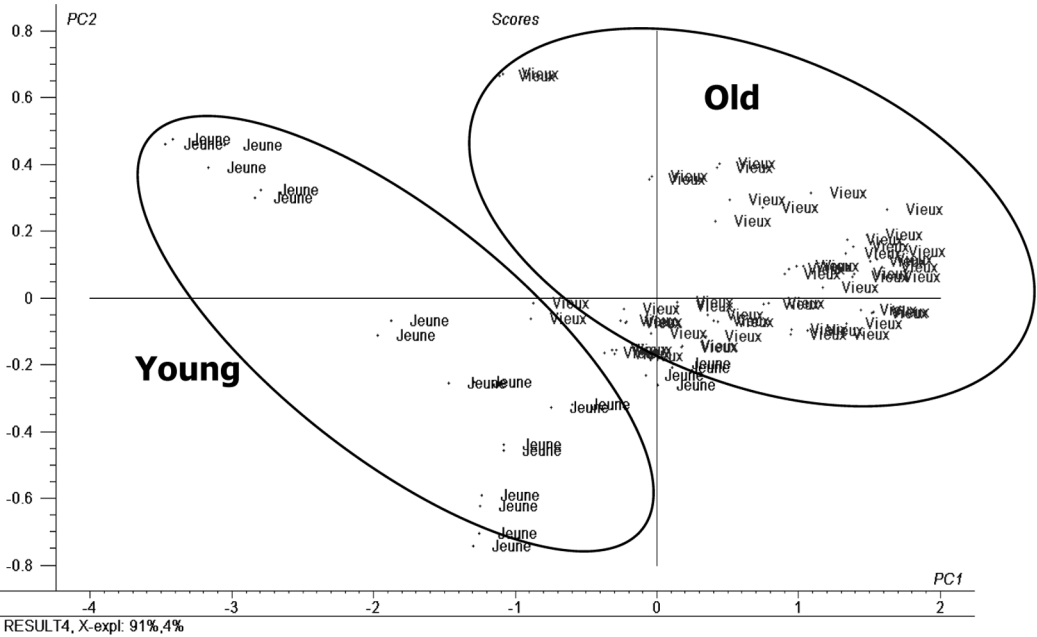


Figure 1. PCA according the age of nuts.

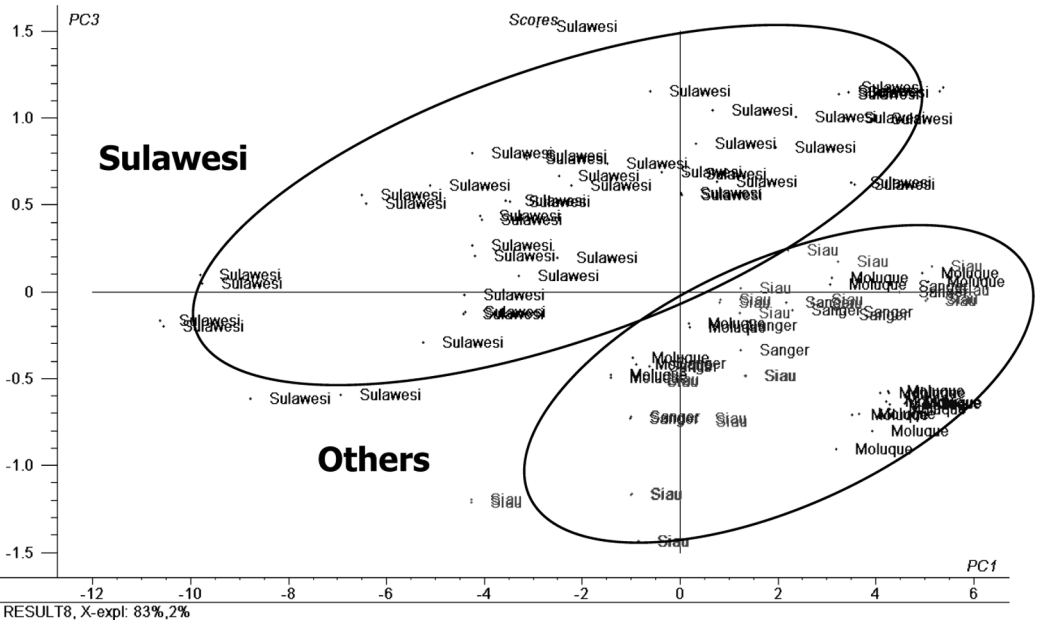


Figure 2. PCA according the geographic origin.

monoterpene alcohols, and an aromatic ether fraction. The aromatic fraction contains myristicin, elemicin, safrole and minor constituents (methyleugenol, eugenol, isoeugenol. . .). The composition of oils varies according to the maturity and the geographic origin of the nuts. The PCA in Figure 1 shows the discrimination of oils according the maturity of nuts. The young nuts were harvested on the tree, the old mature nuts were harvested from the ground, after they had fallen. The second PCA (Figure 2) shows the discrimination according to the geographic origin. The Sulawesi origin is different because it is a large island and land under cultivation is far from the sea, unlike the other islands.

The same results were found, using PCA on gas chromatographic data. The chemical interpretation shown that myristicin, methyleugenol and eugenol are more concentrated in young nuts. The same classification was possible in the NIR data and in the chromatographic data, and it was concluded that NIR spectroscopy could be used in the quality control of nutmeg essential oils, using discriminant methods.