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# Development of a Screening Method for the Authentication of the Botanical Origin of Honey by Mid- Infrared Spectroscopy

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## Introduction

The term unifloral honey is used to describe honey which originates essentially from nectar or honeydew from the indicated plant species. Unifloral honeys are characteristic in composition, flavour and colour. For this reason unifloral honeys have a consumer preference leading to better prices on the market than honey blends. The classical approach to classify unifloral honeys by a global interpretation of sensory, pollen and physicochemical analyses carried out by experts is time-consuming and costly. New and promising analytical approaches have been reported [1].

Fourier transform mid-infrared spectroscopy using an attenuated total reflectance cell (ATR-MIR) was applied to model a spectral-library basing on the spectral characteristics of 6 different unifloral honey types.

The aim of the current work was to evaluate if the infrared spectroscopic characteristics of the investigated honey types allow a reliable determination of the botanical origin of a honey sample by comparing its ATR-MIR-spectroscopic data with the spectral-library.



Fig. 1: Investigated Unifloral Honey Types  
Acacia, Heather, Lime, Rape, Honeydew, Fir

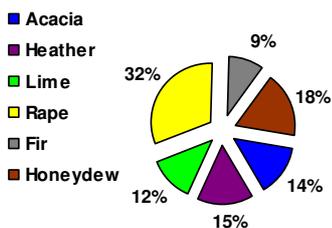


Fig. 2: Distribution of the investigated Unifloral Honeys

## Literature

- [1] Ruoff et al., Authentication of the Botanical and Geographical Origin of Honey by Mid-Infrared Spectroscopy, J. Agric. Food Chem., 2006, 54/18, 6873-6880
- [2] Codex Alimentarius, Alinorm 41/0: Revised standard for honey, 2001, Alinorm 1, 19-26
- [3] Council Directive 2001/110/EC of 20 December 2001 relating to honey, Off. J. Eur. Communities 2002, L10, 47-52

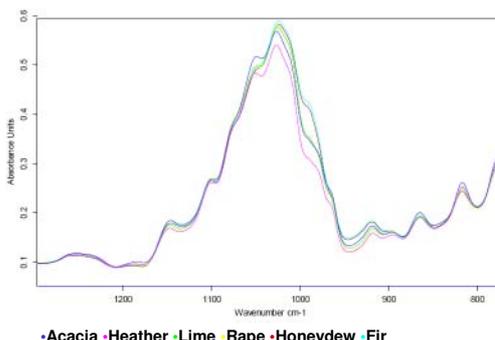


Fig. 3: Fingerprint Area of the Infrared Spectra

## Method

239 honey samples produced between 2004 and 2008 were classified with classical methods [2, 3] and assigned to one of the following 6 honey types: Acacia (*Robinia pseudoacacia*), heather (*Calluna vulgaris*), lime (*Tilia spp.*), rape (*Brassica napus*), fir honeydew (*Abies spp. And Pice spp.*), and honeydew (Fig. 1, 2).

FT-MIR-Spectra of the 239 honey samples were recorded using a Tensor 27 (Bruker, Ettlingen, G) with ATR-cell. In a first step clustering structures of the different honey types were visualised by applying principal component analysis (PCA) (Fig. 4). The IDENT-method (OPUS 6.5, Bruker) was developed after multivariate data analysis and selection of significant spectral ranges (wave number range between 4000 and 550 cm<sup>-1</sup>). The developed IDENT-method (spectral library) consists of one head library and 4 sub libraries on 3 different levels (Fig. 5). The validation was carried out with spectra not present in the group of samples used to build the model (Fig 6).

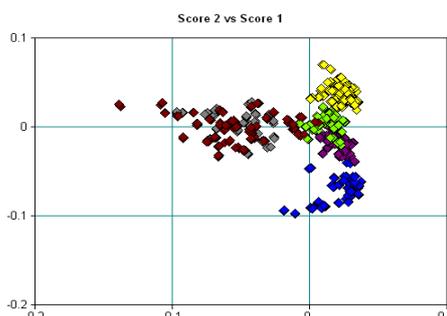


Fig. 4: 239 Honey Samples of 6 different Unifloral Honey Types (PCA)

## Results and Discussion

The developed IDENT-method is basing on the spectral correlation of 696 spectra of a total sample set of 239 honey samples. Only 1.3 % of the spectra could not be assigned to the library-model (Fig. 5). The IDENT-method was tested for 72 honey samples, so far. Most of the unifloral honeys revealed very high rates of correct classification (Acacia 100%, Heather 92%, Lime 100%, Rape 97%, Honeydew 71%). The results demonstrate that the model used was robust. The misclassification of 29 % of the honeydew honeys may be explained by the variable composition of this honey type. Before this new method can be used for routine honey control, it has to be tested with a sufficient number of authentic unifloral samples. The range of the method has to be amplified for more honey types, unifloral and polyfloral.

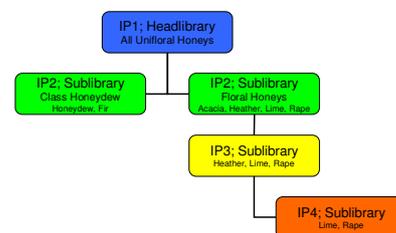


Fig. 5: Model of the spectral library (IDENT-method)

## IDENT-ANALYSIS

### Classification of Honey Samples

1. Measure new Sample
2. Compare with Library
3. Result

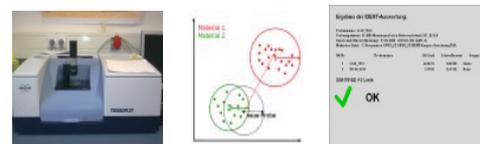


Fig. 6: Principle of the Ident-Analysis

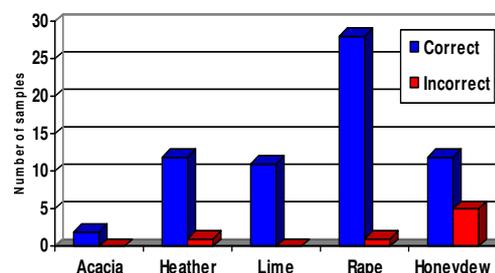


Fig. 7: Results of the IDENT-ANALYSIS (N = 72 samples)