CHEMICAL PROFILE OF DIFFERENT TYPES OF MEAD. NMR METABOLOMICS APPLIED TO THE OLDEST ALCOHOLIC BEVERAGE

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INTRODUCTION

Mead (honey wine) is the oldest alcoholic beverage known for its antioxidant and therapeutic properties. Traditional mead is made from honey and water via fermentation with yeast. Honey wines of different type are obtained using fruits, herbs and spices during or after the fermentation. Differences in the quality and type of honey due to difficulties of the production process triggered the replacement of mead by other alcoholic beverages, mainly wine and beer. However the consumption of mead in Europe and America is steadily increasing in the last decade, but only scarce information on the chemical composition of honey wines is available so far.

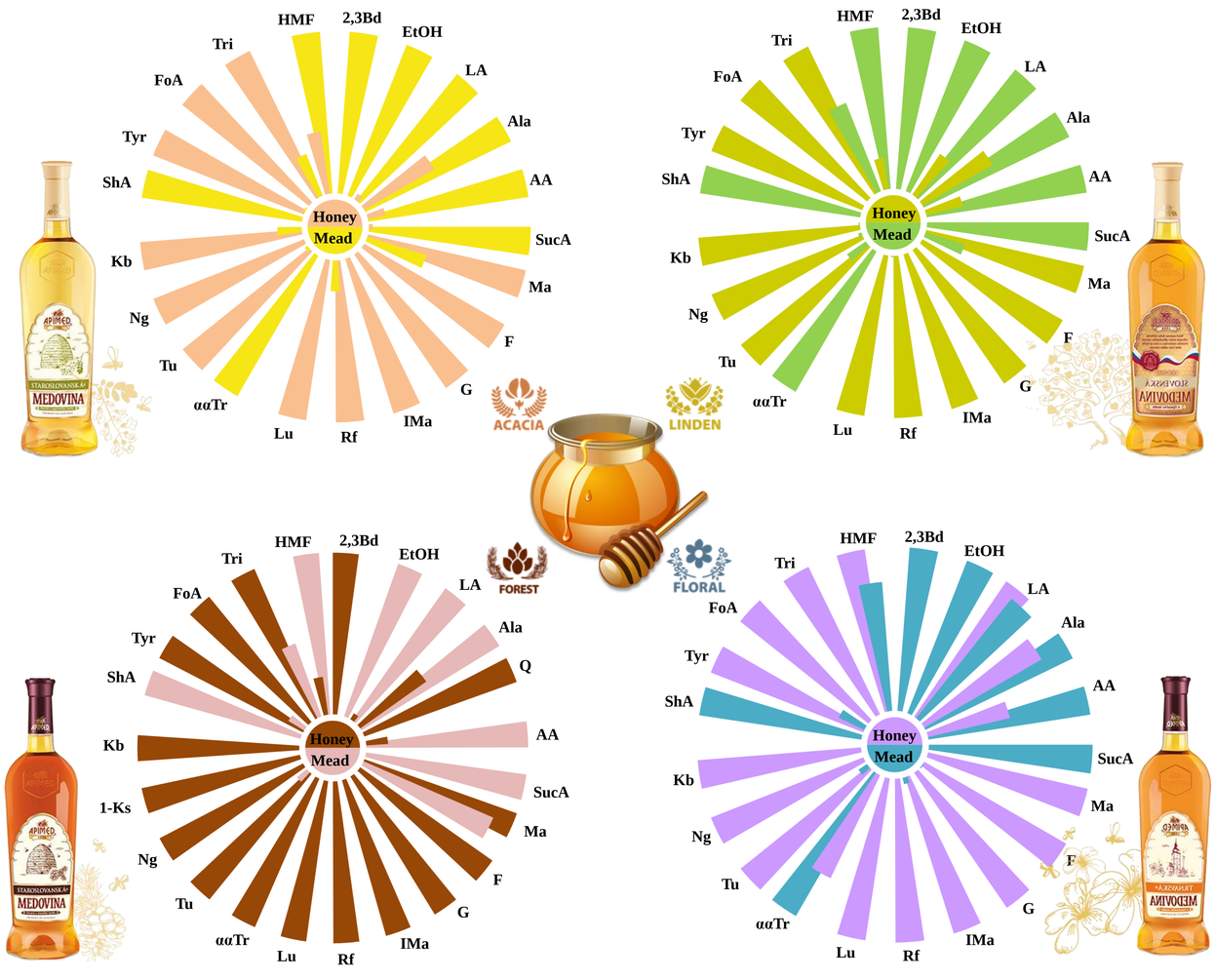
In the present study twenty meads from Bulgaria, Poland and Slovakia produced from linden, acacia, honeydew or polyfloral honey were analyzed using ^{1}H NMR spectroscopy. Different chemometric methods were used to determined the components, which differentiate meads based on their type and geographical origin.

SAMPLES

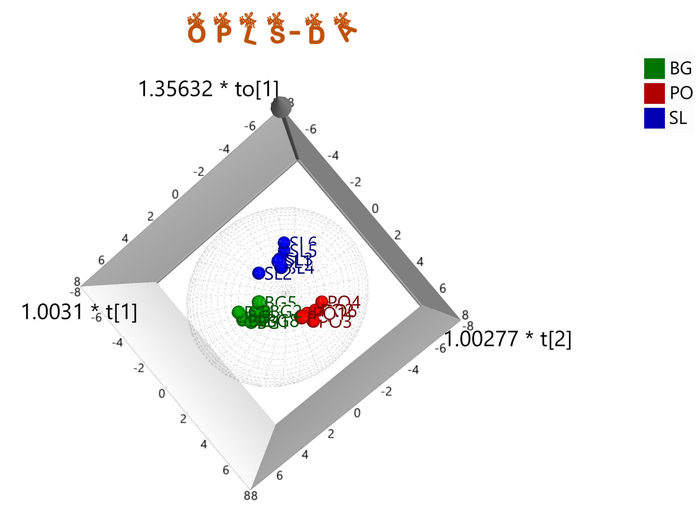
20 honey wines of three different types – traditional mead, melomel (mead with fruit juice) and meteglin (mead with herbs), produced in three countries (Bulgaria, Poland and Slovakia) were selected. 495 µl mead was diluted with 10% deuterated buffer solution (pH=2.9). pH of the samples was adjusted to 3.10 with 8.5% H_3PO_4. 0.1% 3-(trimethylsilyl)propanoic acid sodium salt (TSP) was added as internal standard. 1D and 2D NMR spectra were acquired at 300.0±0.1K on Bruker Avance II$^+$ 600 NMR spectrometer using a BBO probehead.

RESULTS AND DISCUSSION

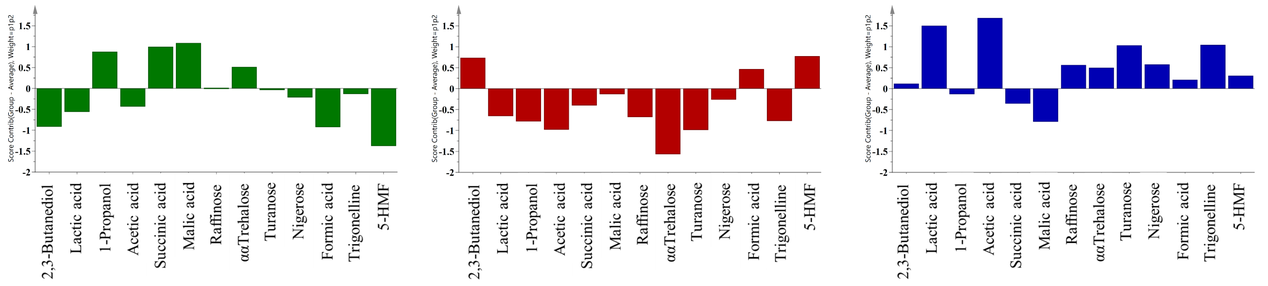
^{1}H NMR spectra with water suppression were used for identification and quantification of 36 compounds – amino and organic acids, alcohols, sugars and phenolic substances. The chemical profiles of traditional meads produced from acacia, linden, honeydew (forest) and polyfloral honey were compared with the chemical profiles of the corresponding four types of honey. Quantities of 21 (23) identical components in nectar (honeydew) honeys and meads are presented using Nightingale's diagrams.



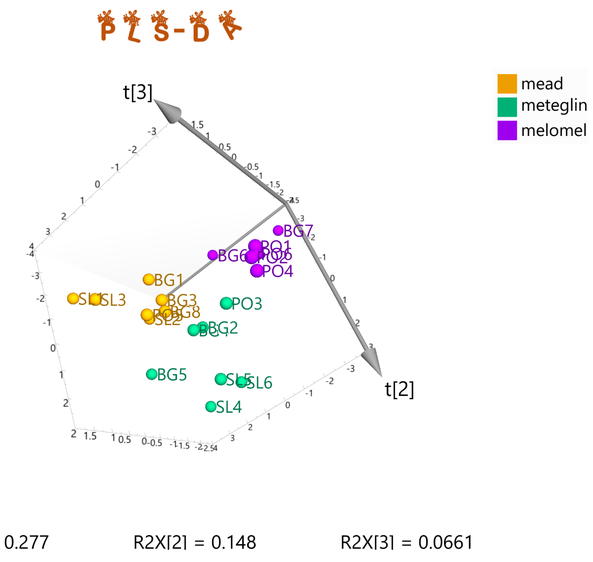
Nightingale's diagrams clearly show the differences between the composition of meads and honeys. Honeys contain more carbohydrates (except αα-trehalose) and amino acids, while meads are rich in alcohols (2,3-butanediol, ethanol) and organic acids (lactic, acetic, succinic and shikimic acids), probably due to fermentation processes.



R2X[1] = 0.322 R2X[2] = 0.268 R2Xo[1] = 0.146



OPLS-DA method allows unambiguous differentiation of the geographical origin of meads based on 13 compounds. Bulgarian honey wines contain more 1-propanol, succinic and malic acids, Polish meads are rich in 2,3-butanediol, formic acid and 5-HMF, while Slovakian meads have more disaccharides (nigerose, turanose), trigonelline, lactic and acetic acids.



R2X[1] = 0.277 R2X[2] = 0.148 R2X[3] = 0.0661

The three different mead types – traditional, meteglin and melomel can be distinguished by a score plot of PLS-DA model. Traditional meads are composed mostly of alcohols and sugars, meteglins contain more acetic acid and isopentanol, while melomels have higher concentration of acids, monosaccharides and choline.

CONCLUSION

This investigation indicates that NMR-based metabolomics is a useful and reliable method for analysis and authentication of mead. Chemometric techniques allow determination of geographical origin and type of meads, while prove of the botanical origin of the honey used for mead production was not successful.

ACKNOWLEDGEMENT

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