IDENTIFICATION OF HONEY VOLATILE COMPONENTS BY SOLID PHASE MICROEXTRACTION (SPME) AND GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS)

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Summary

Volatile compounds in honey samples of different botanical origins were investigated. Solid phase microextraction (SPME) and gas chromatography-mass spectrometry (GC/MS) revealed a total of 86 compounds in the headspace of 4 types of honey – multifloral, heather, buckwheat and lime-honeydew. The chemical composition of the headspace was very diverse, owing to the presence of compounds from different chemical classes, for instance: alcohols, fenols, ketones, organic acids, esters and hydrocarbons (aliphatic, aromatic and cyclic). The performed analysis showed that the obtained volatile profiles of the examined honeys differed and it was concluded that analysis of the volatiles could be effective for the characterization of the honeys botanical source.

Keywords: Honey, volatile compounds, solid phase microextraction (SPME), gas chromatography (GC), mass spectrometry (MS).

INTRODUCTION

The current Polish standards favour three types of honey: nectar, honeydew and nectar-honeydew. The nectar honeys include: acacia honey, heather honey, buckwheat honey, multifloral honey and lime honey. The honeydew honeys include: leafy honeydew and coniferous honeydew. In order to specify the origin of the honey, organoleptic and physical methods are most frequently used. These methods include: an examination of color, taste, smell and the crystallization process. In exceptional cases, pollen analysis is used. This procedure relies on the identification of pollen by microscopic examination.

This paper is a continuation of work previously presented at the XLIII International Apicultural Scientific Conference in Puławy (Wolski et al. 2006).

Studies to date have been conducted into various aspects of volatile honey components. Several authors have investigated the composition of honey volatiles in order to differentiate the botanical origins of various types of honey (Verzera et al. 2001; De la Fuente et al. 2005; Radovic et al. 2001; Guyot et al. 1998; Soria et al. 2002, 2004; Thrasyvoulou et al. 2002; Anklam, 1998; Bianchi et al. 2005; Guyot-Declerc et al. 2002; Piasenzotto et al. 2003).

The aim of other studies was to assess the composition of volatiles on the creation of aroma and other organoleptic properties of honey (Wintersteen, Cadwallader

2001; Overton, Manura 1999; Alissandrakis et al. 2003).

There are also publications available combining the composition of honey volatiles with environmental pollution (Bentivenga et al. 2004).

Regarding the chemical composition of volatiles, different authors report that the same volatile components are present in the majority of honeys, although the mutual proportions of these substances can be different (Verzera et al. 2001; De la Fuente et al. 2005; Radovic et al. 2001; Soria et al. 2002, 2004; Thrasyvoulou et al. 2002; Anklam 1998; Piasenzotto et al. 2003; Overton, Manura 1999). Similarly, some components are unique to particular types of honey only.

Verzera et al. (2001) used the SPME--GC/MS to study, among others: orange, eucaluptus and chestnut honeys, and affirmed the occurrence of 113 volatile compounds belonging to the following classes of compounds: acyclic and monocyclic monoterpens and their oxygenated derivatives, furan and sulfuric derivatives, aliphatic, aromatic and nitrogenous compounds. The majority of these substances were present in all studied samples and only some of them could be considered as potential markers of the botanical origin of a given type of honey.

For example, as marker compounds of chestnut honey only the following were considered: acetophenone, 2-aminoacetophenone, 1-phenylethanol. Eucalyptus honey was also characterized by a high content of nonanol, nonanal, nonanoic acid, 5-hexene-2-ol and 2,3-dimethyl-5-hexene--2-ol because of the scarce quantities of these substances in different honeys.

The studies of a Belgian analyst using GC/MS found the presence of 400 volatile compounds in 11 floral honeys. From all of those 72 occurred in higher quantities than 1 ppb. Only four volatile compounds: 2-furalaldehyde, benzyl alcohol, 2-phenylethanol, 8-p-methene-1,2-diol have occurred in lime tree honey in higher quantities than 1 ppb. In the case of chestnut honey from *Castanea sativa*, 5 of such compounds were confirmed: 2-furalaldehyde, 2-methyl-butanoic acid, furfuryl alcohol, 5-methylfurfural, and benzyl alcohol (Guyot et al. 1998).

Radovic et al. (2001) identified 110 volatile compounds in 43 samples of honey with the Purge & Trap-GC/MS method from various botanical and geographical origins. The authors found the presence in the majority of studied samples of the following: linear and branched aldehydes, ketones and short-chain alcohols.

Studies by Overton and Manura (1999) showed the presence of from 50 to 100 compounds in each of the studied samples originating from the USA. In the volatile fraction they found numerous mono- and sesquiterpene compounds as well as aromatic substances such as: benzaldehyde, furfural, isovaleraldehyde and phenyloacetaldehyde. From among other compounds, they distinguished the presence of: lilac aldehyde, lilac alcohol, linalool oxide, tetrahydro-furfuryl alcohol, 3,5,5-trimethylo-2-cyclohexen-1-one, 2-cycloheksen-1-one, isoamyl alcohol and cis-jasmone. The authors also affirmed the presence of: octane, hexanal, octanal, nonanal and decanal forming in honey during its storage as a consequence of oxygenation of fatty acids (mainly of linoleic and linolenic acids). Moreover, in each of the studied samples, the authors affirmed the presence of toluene – suggesting that it is a compound occurring naturally in honey.

The aim of the current study was to identify the volatile honey components present in 4 types of honey – multifloral, heather, buckwheat and lime-honeydew – using SPME/GC/MS techniques.

MATERIALS AND METHODS

Materials:

Four honeys (multifloral, heather, buckwheat and lime-honeydew) were analyzed to compare the flavor profiles and to qualify and quantify the volatile organics that were present.

The samples of honey were obtained from Apiculture Department of Research Institute of Pomology and Floriculture in Puławy in Poland.

The LRI were determined by injection of a solution containing the homologous series of normal alkanes: FLUKA "Alkane standard solution C8-C20", Sigma-Aldrich, no. 04070.

Solid phase microextraction (SPME) procedure:

The SPME procedure was performed using a manual SPME holder (Supelco) equipped with a 65 µm polydimethylosiloxane/divinylbenzene (PDMS/DVB) (Supelco) coating. Before the each use of the fiber it was conditioned at the GC injection port, at a temperature of 250°C for 30 minutes.

About 1-1.5 g of the investigated sample was placed into a 4 ml vial closed with a screw and heated to 40°C for 60 minutes and the fibre was then exposed to honey headspace. After 30 min, the SPME fiber was withdrawn from the vial and promptly introduced into the GC injector under the conditions reported below.

Gas chromatography-mass spectrometry (GC/MS) procedure:

GC/MS analyses were performed using Agilent 6890 GC coupled to an Agilent 5975 quadrupole mass detector.

The SPME fiber was desorbed in GC injector at 220°C for 5 minutes in splitless mode and chromatographic separation was carried out on a 30 m x 0.25 mm x 0.25 µm film thickness HP-5MS (5% Phenyl Methyl Siloxane) capillary column. The GC oven temperature was programmed from 40°C (held for 5 min.) to 250°C at a rate of 5°C. Helium was used as a carrier gas at a constant flow of 0.9 ml/min. Mass spectra were recorded in EI mode at 70 eV, scanning the 20-550 m/z range. The interface and source temperature were 150 and 230°C, respectively.

The identification of the isolated volatile compounds was achieved by comparing obtained mass spectra of unknown peaks with those stored in the NIST.02 (US National Institute of Standards and Technology) and Wiley.7n. mass spectral electronic libraries. Identifications were confirmed where possible, by comparison with authentic substances used as references and by use of linear retention indices (LRI).

Relative area values (as a percentage of total volatile composition) were directly obtained from total ion current (TIC). All analyses were carried out in duplicate.

RESULTS AND DISCUSSION

The identified volatile compounds of investigated samples are presented in Table 1.

An exemplary volatile profile of heather honey is presented in Fig. 1.

In four analysed honeys, 86 compounds were identified: including 66 in multifloral honey, 56 in heather honey, 58 in buckwheat honey and 55 in lime-honeydew honey.

Identified compounds belonged to different chemical classes as follows: alcohols: e.g. ethanol, 1-propanol, 2-methyl-, 2,3-butanediol; phenols: e.g. phenol, 3,4,5-trimethyl-; ketones: e.g. acetone, acetophenone, butyrolactone; organic acids: e.g. formic acid, acetic acid, butanoic acid; esters: e.g. ethyl acetate, methyl salicylate; aldehydes: e.g. butanal, 3-methyl-, furfural, nonanal; aliphatic hydrocarbons: e.g. octane, nonane; aromatic hydrocarbons: e.g. toluene, vinylobenzene; hydrocarbons cyclic: e.g. D-limonene.

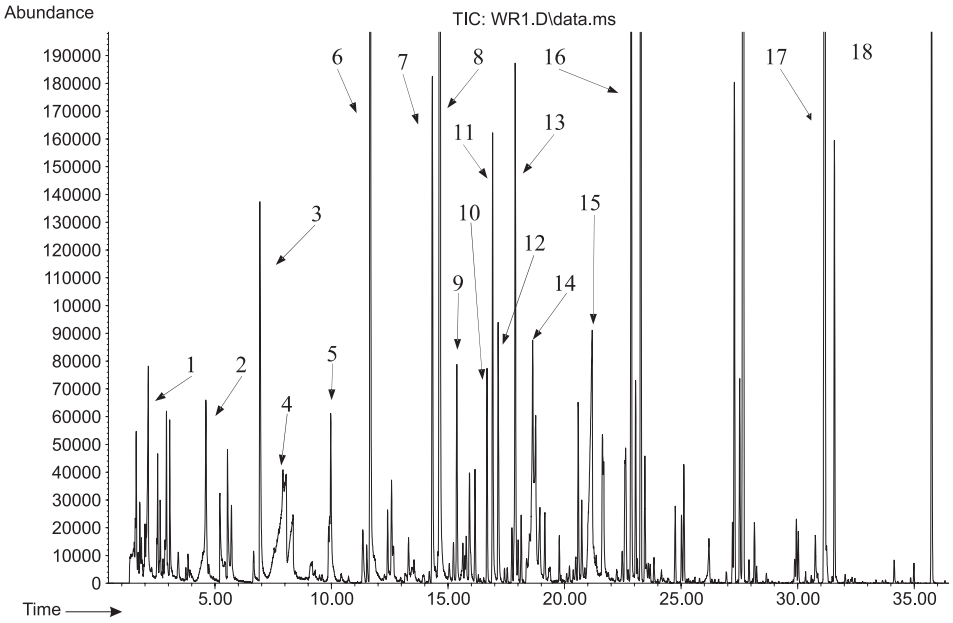

Fig. 1. Exemplary volatile profile of heather honey.
1. Acetic acid; **2**. Toluene; **3**. Furfural; **4**. Butanoic acid, 3-methyl-; **5**. Butyrolactone; **6**. Benzaldehyde; **7**. Benzenemethanol; **8**. Benzeneacetaldehyde; **9**. Acetophenone; **10**. Nonanal; **11**. Benzeneethanol; **12**. 2-Cyclohexen-1-one, 3,5,5-trimethyl-; **13**. 2,6,6-Trimethyl-2-cyclohexene-1,4-dione; **14**. Benzoic acid; **15**. Benzeneacetic acid; **16**. Phenol, 3,4,5-trimethyl-; **17**. Benzene, 1,2,4-trimethyl-; **18**. Isobutyl phthalate

From among the 86 identified compounds, 37 were found in all analysed samples, however, their mutual proportions were substantially different.

For example, the amount of ethanol (which was probably generated by fermentation during prolonged storage of honey) was 121 times higher in lime-honeydew honey than in the heather honey, 971 times higher than in the buckwheat honey, and 57 times higher than in the multifloral honey.

The compounds that were present in unifloral honeys were also generally present in multifloral honey.

Compounds identified in unifloral honeys, but not found in the multifloral honey

In unifloral honeys there were compounds identified which were not found in multifloral honey, as follows:

— the heather honey: acetone; formic acid; butanal, 3-methyl-; butanal, 2-methyl; phenol, 4-methyl-; benzenepropanol; cinnamyl alcohol; phenol, 2,6-dimethoxy-; cumene, 2,4,5-trimethyl- ;
— the buckwheat honey: butanal, 3--methyl-; butanal, 2-methyl-; butanoic acid; pentanoic acid; 2(3H)-furanone, dihydro-4-methyl-; phenol, 4-methyl-; 2-acetylaniline; 3,5-dimethoxybenzaldehyde; geranyl acetone; isopropyl myristate; dibutyl phthalate;
— the lime-honeydew honey: 3-buten-1--ol, 3-methyl-; bicyclo[2.2.1]hept-2--ene, 2,3-dimethyl-; phenol, 4-methyl-; 1H-inden-1-one, 2,3-dihydro-; 2(3H)--furanone, dihydro-5-pentyl-; geranyl acetone.

Compounds identified in multifloral honey, but not found in unifloral honeys

Similar to multifloral honey, there were compounds identified which were not found in any of the remaining (heather, buckwheat, lime-honeydew) honeys. It mainly concerns the following compounds: vinylbenzene (27), D-limonene, lilac alcohol, 3-hydroxy-4-phenyl-2-butanone, eugenol, isoeugenol.

Specific compounds for particular kinds of unifloral honey

In each of the analysed honeys there were compounds identified, which were

Table 1

Volatile compounds identified in investigated honey samples, expressed as percent of total chromatogram area.

COMPOUND	HONEY TYPE			
	MULTIFLORAL	HEATHER	BUCKWHEAT	LIME-HONEYDEW
Ethanol	0.34	0.16	0.02	19.43
Acetone (2-Propanone)	-	0.53	-	-
Dimethyl sulfide	0.80	0.10	0.13	1.36
Formic acid (Methanoic acid)	-	0.23	-	-
Acetic acid (Ethanoic acid)	1.17	1.10	0.36	2.16
Ethyl Acetate (Acetic acid, ethyl ester)	0.09	-	-	0.44
1-Propanol, 2-methyl- (Isobutyl alcohol)	0.16	-	-	2.20
Butanal, 3-methyl- (Isovaleraldehyde)	-	0.54	0.68	-
Butanal, 2-methyl- (Butyraldehyde, 2-methyl-)	-	0.36	0.66	-
Pentane, 2,2,4-trimethyl- (Isooctane)	0.83	0.48	0.08	4.23
3-Buten-1-ol, 3-methyl- (Isobutenylcarbinol)	-	-	-	0.33
1-Butanol, 3-methyl- (Isopentyl alcohol)	0.44	0.10	0.18	2.10
1-Butanol, 2-methyl- (sec-Butylcarbinol)	0.48	0.08	0.19	1.31
2-Butenal, 2-methyl- (Crotonaldehyde, 2-methyl-)	0.24	-	0.12	-
Propanoic acid, 2-methyl- (Isobutyric acid)	0.10	0.28	0.12	0.13
Toluene (Benzene, methyl)	6.65	1.27	0.39	1.84
2-Buten-1-ol, 2-methyl-	0.23	-	0.13	0.14
2-Buten-1-ol, 3-methyl- (Prenyl alcohol)	0.15	-	-	0.21
2,3-Butanediol (2,3-Butylene glycol)	0.15	0.72	0.09	0.77
Octane (n-Octane)	0.35	0.47	0.75	0.65
Butanoic acid (Butyric acid)	-	-	0.45	-

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Table 1

Volatile compounds identified in investigated honey samples, expressed as percent of total chromatogram area.

COMPOUND	HONEY TYPE			
	MULTIFLORAL	HEATHER	BUCKWHEAT	LIME-HONEYDEW
Furfural (2- Furancarboxaldehyde)	0.86	2.19	4.85	8.20
2-Furanmethanol (Furfuryl alcohol)	1.14	0.11	0.14	0.99
Butanoic acid, 3-methyl- (Isovaleric acid)	0.65	1.82	24.45	-
Butanoic acid, 2-methyl- (Butyric acid, 2-methyl-)	0.11	1.10	13.20	-
Bicyclo[2.2.1]hept-2-ene, 2,3-dimethyl- (Santen)	-	-	-	0.20
Styrene (Vinylbenzene)	0.19	-	-	-
Nonane (n-Nonane)	0.07	-	0.04	-
Oxime-, methoxy-phenyl-	0.09	0.20	-	0.36
Ethanone, 1-(2-furanyl)- (2-Acetylfuran)	0.42	0.25	3.28	2.56
Butyrolactone (2(3H)-Furanone, dihydro-)	0.12	1.13	2.18	1.24
Pentanoic acid (Valeric acid)	-	-	3.05	-
2(3H)-Furanone, dihydro-3-methyl- (2-Methylbutanolide)	0.08	-	2.11	0.23
2(3H)-Furanone, dihydro-5-methyl- (Valerolactone)	1.06	0.18	0.60	0.39
Benzaldehyde (Phenylmethanal)	10.91	7.32	10.45	3.76
2(3H)-Furanone, dihydro-4-methyl-	-	-	10.29	-
Furfural, 5-methyl- (2-Furancarboxaldehyde, 5-methyl-)	0.11	-	-	0.48
Phenol (Benzenol)	0.13	0.52	0.19	0.36
Hexanoic acid (Caproic acid)	0.16	0.20	0.17	1.64
Octanal (Caprylaldehyde)	0.11	-	-	0.14
D-Limonene (Cyclohexene, 1-methyl-4-(1-methylethenyl)-, (R)-)	0.07	-	-	-
Benzyl Alcohol (Benzenemethanol)	1.28	2.77	1.06	3.56
Benzeneacetaldehyde (Phenylethanal)	10.74	15.41	0.54	1.46
Benzenemethanol, α-methyl- (α-Phenethyl alcohol)	0.08	0.20	-	0.22
Acetophenone (Ethanone, 1-phenyl-)	0.15	1.12	0.08	0.32
cis-Linalool oxide (Z)- (2- -Furanmethanol, 5-ethenyltetrahydro- α,α,5-trimethyl-, cis-)	0.82	0.24	0.32	0.91

Table 1

Volatile compounds identified in investigated honey samples, expressed as percent of total chromatogram area.

COMPOUND	HONEY TYPE			
	MULTIFLORAL	HEATHER	BUCKWHEAT	LIME-HONEYDEW
Phenol, 4-methyl- (p-Cresol)	-	0.11	2.38	0.29
2,5-Furandicarboxaldehyde (5-Formylfurfural)	0.62	0.24	0.23	0.71
Methyl 2-furoate (2-Furancarboxylic acid, methyl ester)	0.48	0.71	1.22	1.44
trans linalool oxide (E)-	0.31	-	0.24	-
Linalool (1,6-Octadien-3-ol, 3,7-dimethyl-)	0.24	-	0.05	0.22
Nonanal (n-Nonylaldehyde)	0.12	0.95	1.78	1.88
Phenylethyl Alcohol (Benzeneethanol)	3.56	2.25	0.63	4.16
2-Cyclohexen-1-one, 3,5,5-trimethyl- (Isophorone)	0.62	1.39	0.08	0.63
Benzyl methyl ketone (2-Propanone 1-phenyl-)	0.25	0.05	-	-
Benzyl nitrile (Benzeneacetonitrile)	2.68	0.26	0.20	0.05
2,6,6-Trimethyl-2-cyclohexene-1,4-di one (4-Oxoisophorone)	3.14	2.76	0.53	1.03
2-Hydroxy-3,5,5-trimethyl-cyclohex -2-enone	0.30	0.21	-	-
Lilac aldehyde (2-(5-Methyl-5-vinyltetrahydro-2- -furanyl)-1-propanal)	0.92	0.31	0.19	0.41
Benzoic Acid (Benzenecarboxylic acid)	1.94	1.91	0.58	1.39
1-Nonanol (Nonyl alcohol)	0.09	0.08	0.35	0.16
Octanoic Acid (Caprylic acid)	0.68	0.53	0.35	1.17
Methyl salicylate (Benzoic acid, 2-hydroxy-, methyl ester)	0.18	-	0.11	1.34
Decanal (Capraldehyde)	0.25	0.18	0.33	1.03
Lilac alcohol (2-(5-Methyl-5-vinyltetrahydro-2- -furanyl)-1-propanol)	0.17	-	-	-
Benzenepropanol (1-Propanol, 3-phenyl-)	-	0.13	-	-
Benzeneacetic acid (Acetic acid, phenyl)	6.72	3.34	-	-
Cinnamaldehyde, (E)- (2-Propenal, 3-phenyl-)	0.14	0.85	0.38	1.40

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Table 1

Volatile compounds identified in investigated honey samples, expressed as percent of total chromatogram area.

COMPOUND	HONEY TYPE			
	MULTIFLORAL	HEATHER	BUCKWHEAT	LIME-HONEYDEW
Nonanoic acid (Pelargonic acid)	0.41	0.55	0.62	0.35
1H-Inden-1-one, 2,3-dihydro- (1-Indanone)	-	-	-	0.24
Ethanone, 1-(2-aminophenyl)- (2-Acetylaniline)	-	-	0.44	-
2-Propen-1-ol, 3-phenyl (Cinnamyl alcohol)	-	0.41	-	-
Phenol, 3,4,5-trimethyl- (3,4,5-Hemimellitenol)	0.78	4.47	-	0.60
3-Hydroxy-4-phenyl-2-butanone	4.00	-	-	-
Phenol, 2,6-dimethoxy- (Syringol)	-	0.12	-	-
Phenol, 2-methoxy-4-(2-propenyl)- (Eugenol)	0.05	-	-	-
2(3H)-Furanone, dihydro-5-pentyl- (Nonlacton)	-	-	-	0.88
Decanoic acid (Capric acid)	0.06	-	0.08	-
2-Buten-1-one, 1-(2,6,6-trimethyl-1,3-cyclohexadien-1-yl)- (Damascenone)	0.11	0.36	-	-
3,5-Dimethoxybenzaldehyde	-	-	0.08	-
Phenol, 2-methoxy-4-(1-propenyl)- (Isoeugenol)	0.12	-	-	-
5,9-Undecadien-2-one, 6,10-dimethyl-, (E)- (Geranyl acetone)	-	-	0.18	0.07
Benzene, 1,2,4-trimethyl-5-(1-methylethyl)- (Cumene, 2,4,5-trimethyl-)	-	13.94	-	-
Isopropyl myristate (Tetradecanoic acid, 1-methylethyl ester)	-	-	0.06	-
1,2-Benzenedicarboxylic acid, bis2-methylpropyl) ester (Isobutyl phthalate)	1.29	3.36	0.63	3.18
Dibutyl phthalate (1,2-Benzenedicarboxylic acid, dibutyl ester)	-	-	1.86	-

not found in other unifloral honeys, as follows:

— in heather honey: acetone; formic acid; 2-propanone, 1-phenyl-; 2-hydroxy--3,5,5-trimethyl-cyclohex -2-enone;

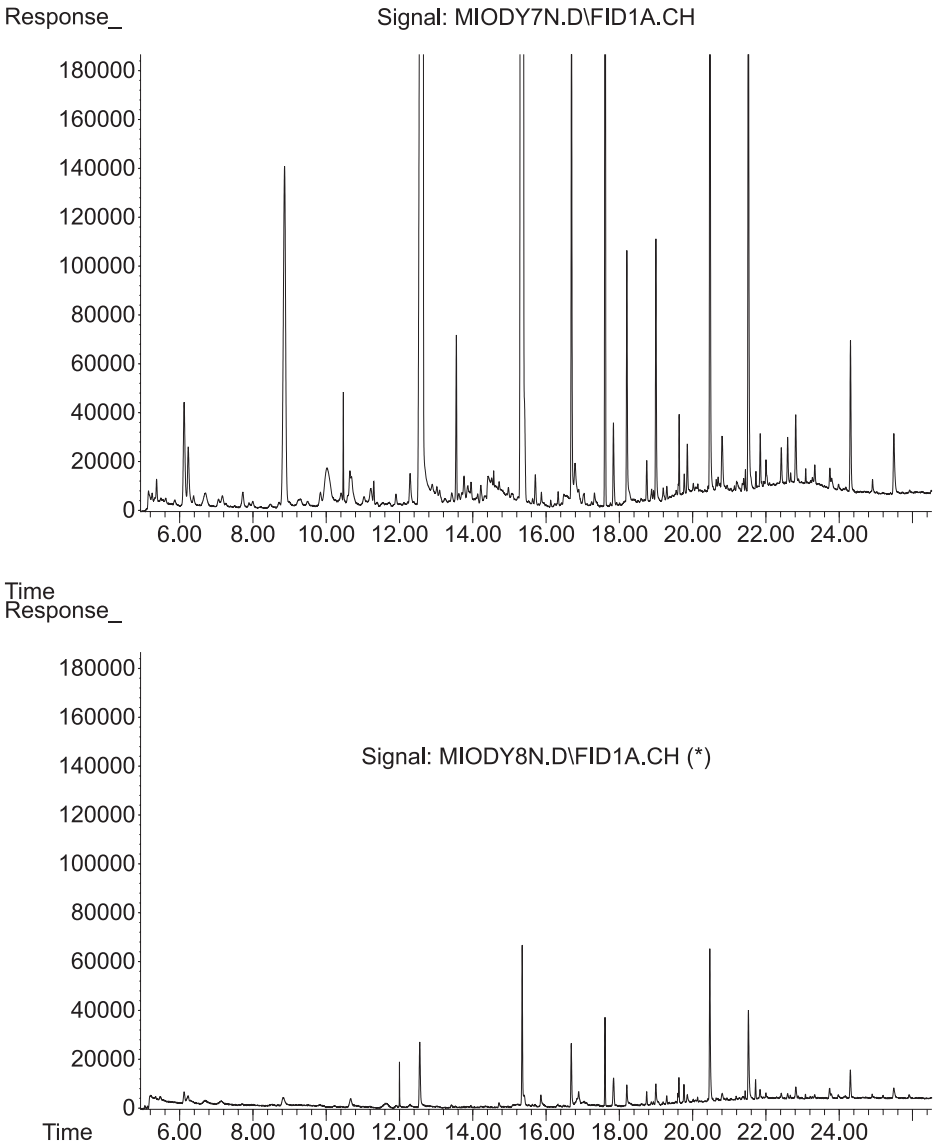

Fig. 2. GC/FID headspace volatile profiles of raspberry honey: fresh honey (top) and honey after 2 month storage at room temperature (down).

benzenepropanol; benzeneacetic acid; cinnamyl alcohol; phenol, 2,6-dimethoxy-; damascenone; cumene, 2,4,5--trimethyl-;

— in buckwheat honey: 2-butenal, 2--methyl-; butanoic acid; nonane; pentanoic acid; 2(3H)-furanone, dihydro-4-methyl-; trans linalol oxide; 2-acetylaniline; decanoic acid; 3,5--dimethoxybenzaldehyde; isopropyl myristate; dibutyl phthalate;

— in lime-honeydew honey: ethyl acetate, 1-propanol, 2-methyl-; 3-buten-1-ol, 3-methyl-; 2-buten-1-ol, 3-methyl-; bicyclo[2.2.1]hept-2-ene, 2,3-dimethyl-; furfural, 5-methyl-; octanal, 1H-

-inden-1-one, 2,3-dihydro-; 2(3H)-furanone, dihydro-5-pentyl- ;

In addition, in each of unifloral honeys, the absence of particular compounds was affirmed in spite of a presence in all other samples (including multifloral honey). This observation concerns the following compounds:

— in the heather honey: 2-buten-1-ol, 2-methyl-; 2(3H)-furanone, dihydro-3--methyl-; linalol; methyl salicylate
— in the buckwheat honey: oxime-, methoxy-phenyl-; benzenemethanol, α--methyl-; phenol, 3,4,5-trimethyl-;
— in the lime honeydew honey: butanoic acid, 3-methyl-; butanoic acid, 2-methyl-;

Comparing the results presented above with other published data (Verzera et al. 2001, De la Fuente et al. 2005, Radovic et al. 2001, Soria et al. 2002, 2004, Thrasyvoulou et al. 2002, Anklam 1998, Piasenzotto et al. 2003, Overton and Manura 1999) the same regularity is found. Most of the components were identified in all of the analysed honeys, but the ratios between the particular components were very different for each different floral origin. Similarly, in each of analysed honeys there were compounds found which were not present in other types of honeys.

CONCLUSIONS

1. In each of analysed unifloral honeys (heather, buckwheat, lime-honeydew), there were compounds found that were not present in other honeys. Therefore, it was concluded that the presence of a particular compound in a particular type of honey, and an absence in others, could be characteristic for a specified type of honey.
2. Most of the components were identified in all of analysed honey samples, but the ratios between the particular components were very different for each different floral origin. Therefore, it was concluded that the amount of particular compound (percentage of total peak area on chromatogram) could be characteristic for a specified type of honey.
3. The lack of particular compound was affirmed for each unifloral honey despite its presence in all remaining samples (including multifloral honey). Therefore, it was concluded that the absence of a particular compound in a particular honey could be a characteristic feature of its type.
4. It was noticed that quantitative and qualitative composition of honey headspace changes over time, particularly when the honey is kept in inappropriate conditions (leaky packaging; too high or too low temperature). An example of such a situation is the presence of ethanol, particularly in the lime-honeydew honey, probably as a result of the fermentation process. It was also observed that the amount and the number of other compounds decreased over time (Fig. 2).
5. Not all compounds present in honey headspace could have been identified in the present stage of work. It was the result of encountered technical problems such as: a lack of spectrum in the mass spectral library; a lack of external standards and a lack of retention indices for the analysed compounds.
6. SPME-GC/MS identification of honey headspace volatile components could be useful in the future for the identification of the botanical and geographical origin of honey, so it is necessary to perform more detailed investigations, including a larger

number of honey samples from various botanical sources.

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IDENTYFIKACJA LOTNYCH ZWIĄZKÓW OBECNYCH W FAZIE NADPOWIERZCHNIOWEJ MIODU PRZY WYKORZYSTANIU TECHNIKI MIKROEKSTRAKCJI DO FAZY STACJONARNEJ ORAZ CHROMATOGRAFII GAZOWEJ SPRZĘŻONEJ ZE SPEKTROMETRIĄ MASOWĄ

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Przedmiotem niniejszej pracy była identyfikacja związków lotnych obecnych w miodach różnych odmian. Przy użyciu mikroekstrakcji do fazy stacjonarnej (SPME) i chromatografii gazowej sprzężonej ze spektrometrią masową (GC/MS) wyizolowano i zidentyfikowano w sumie 86 związków chemicznych występujących w warstwie nad powierzchnią wybranych próbek miodów: wielokwiatowego, wrzosowego, gryczanego oraz lipowo-spadziowego. Skład chemiczny fazy lotnej w miodach okazał się bardzo zróżnicowany. Wykazano występowanie związków z wielu różnych grup chemicznych: alkoholi, fenoli, ketonów, kwasów organicznych, estrów oraz węglowodorów: alifatycznych, aromatycznych i cyklicznych. Analizując wyniki przeprowadzonych badań stwierdzono, że profile lotnych związków badanych odmian miodów różnią się między sobą i w związku z tym uznano, że wykorzystana metoda może być przydatna do identyfikacji miodów odmianowych.

Słowa kluczowe: Miód, związki lotne, mikroekstrakcja do fazy stacjonarnej (SPME), chromatografia gazowa (GC), spektrometria masowa (MS).