







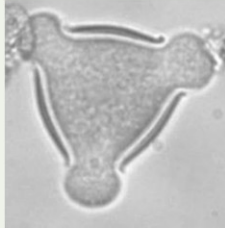
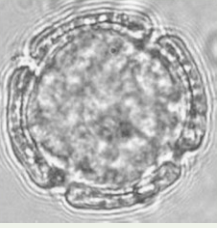
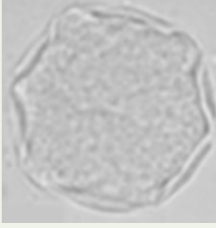
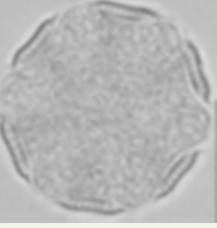
CHARACTERIZATION OF UNIFLORAL HONEYS USING HS-SPME/GC/MS

Stefanie Oelschlägel

Food Chemistry Department ♦ Technical University Dresden ♦ Germany



Authentication of Unifloral Honey

Acacia	Orange	Rosemary	Lavender
			
			





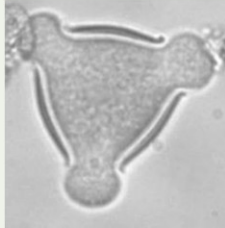
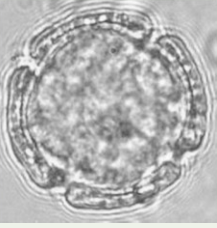
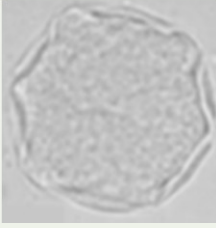
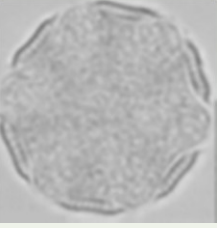


[L. Persano Oddo (2004), G. Beckh & G. Camps (2009), QSI (2011), Guidelines of the German Food Code (2011)]



Authentication of Unifloral Honey

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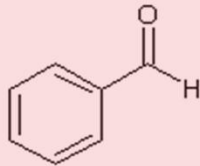
	Acacia	Orange	Rosemary	Lavender
				
				
Pollen [%]	≥ 20	≥ 20	10 - 20	10 - 20
Conductivity [mS/cm]	≤ 0.2	0.1 - 0.3	< 0.2	< 0.3
pH value	4.0 ± 0.1	3.9 ± 0.1	4.0 ± 0.2	3.8 ± 0.1
Taste, Odor	mild, flowery	like orange blossom	mild, flowery	aromatic, flowery
others		2 mg/kg methyl-anthranilate		



Flavoring Substances in Honeys

> 600 compounds identified

• Aldehydes



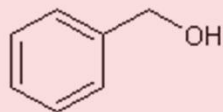
Benzaldehyde

• Alkane acids



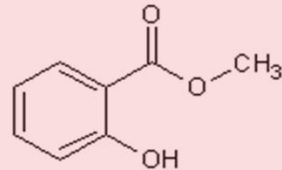
Hexanoic acid

• Alcohols



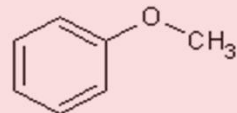
Benzyl alcohol

• Esters



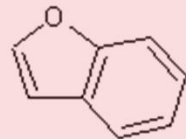
Methylsalicylate

• Ethers



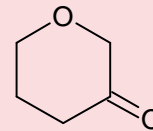
Anisole

• Furan compounds



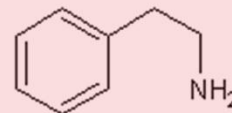
Benzofuran

• Pyranoids



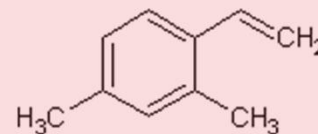
Tetrahydro-2H-
pyran-3-one

• N - compounds



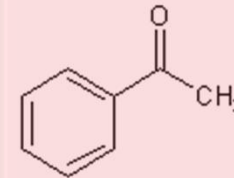
Phenylethylamine

• Styrols



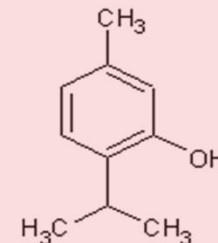
1,4-Dimethylstyrol

• Ketones



Acetophenone

• Monoterpenes



Thymol

• Cl - compounds

• S - compounds



Distinctive Flavoring Substances in Honey Sorts

Determined by HS-SPME-GC/MS

Honey sorts	Samples	Compounds	References
acacia	7	cis-linalool oxide, heptanal	Radovic et al. (2001)
chestnut	10	2-aminoacetophenone, 1-phenylethanol	Piasenzotto et al. (2003)
heather	33	benzyl alcohol, furfuryl alcohol, α -isophorone, 2-phenylethanol, 2,3-butanediol	De la Fuente et al. (2005)
linden	5	dimethylstyrol, carvacrol, thymol, p-cymene, rose oxides, p-methylacetophenone	Lusic et al. (2006)
eucalyptus	22	2-hydroxy-5-methyl-3-hexanone, 3-hydroxy-5-methyl-2-hexanone	De la Fuente et al. (2007)
lavender	6	hexanol, hexanal, heptanal, acetic acid	Jerkovic et al. (2009)



Purpose of Research

Analytical investigation of unifloral honeys
with an optimized HS-SPME-GC/MS Method

Identification of sort-specific flavoring substances

Criteria

- Unique occurrence
- High concentration
- Typical pattern



Purpose of Research

Analytical investigation of unifloral honeys
with an optimized HS-SPME-GC/MS Method

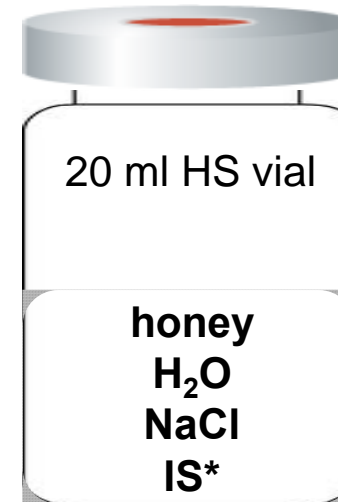
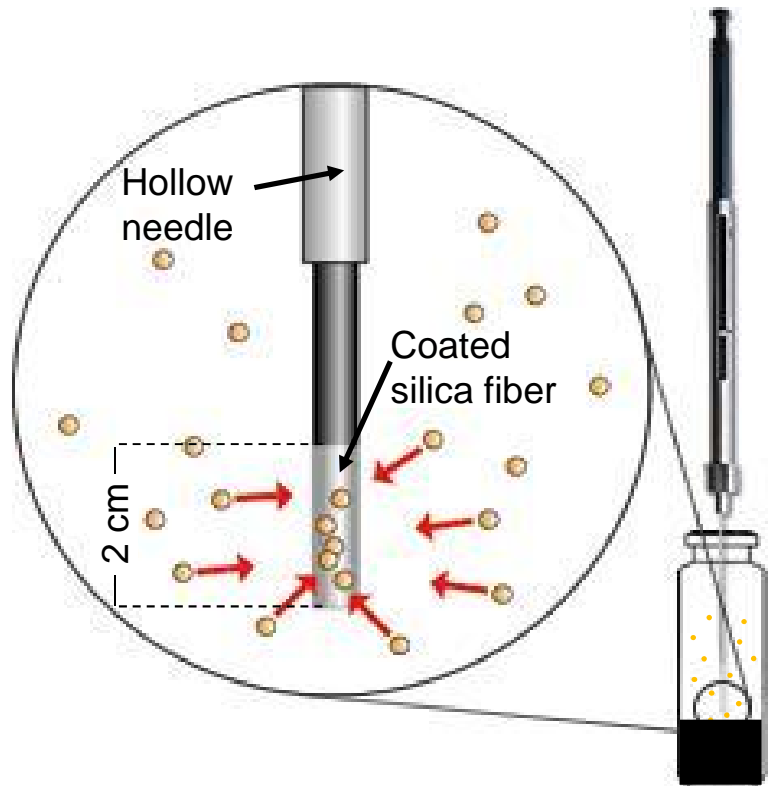
Identification of sort-specific flavoring substances

Blossom honeys	No. of samples			Blend honeys	No. of samples	Honeydew honeys	No. of samples
acacia	15	oregano	3	chestnut	30	pine	7
buckwheat	9	rape	12	eucalyptus	25	fir	9
clover	12	rosemary	9	lime-tree	20	forest	27
dandelion	4	sage	15	manuka	40		
heather	14	sunflower	15				
lavender	20	thyme	15				
orange	10						

∑ 311 honeys



Headspace Solid-Phase Microextraction (HS-SPME-GC/MS)

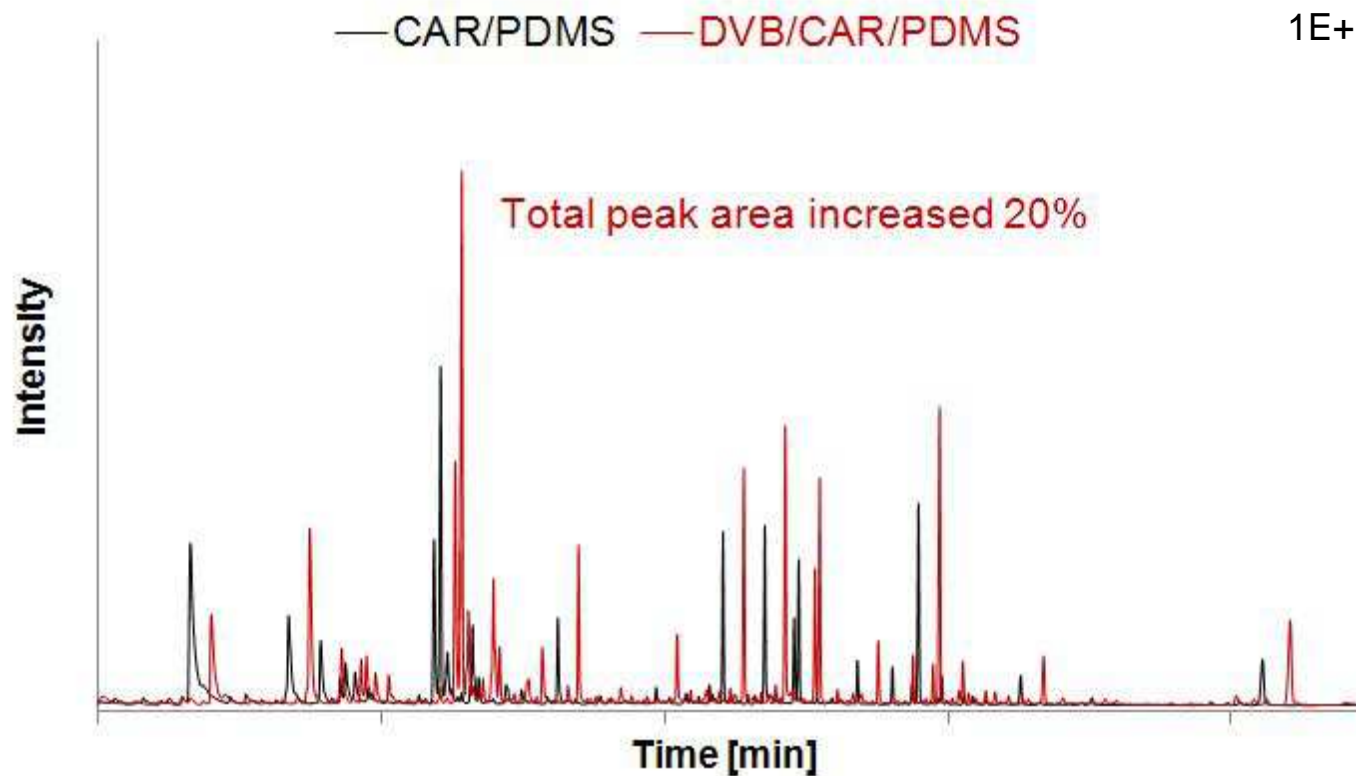


*internal standard
(benzaldehyde-d₆)

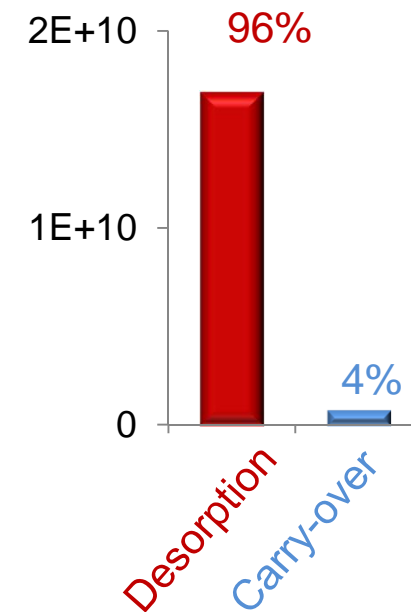


Headspace Solid-Phase Microextraction (HS-SPME-GC/MS)

Fiber Comparison

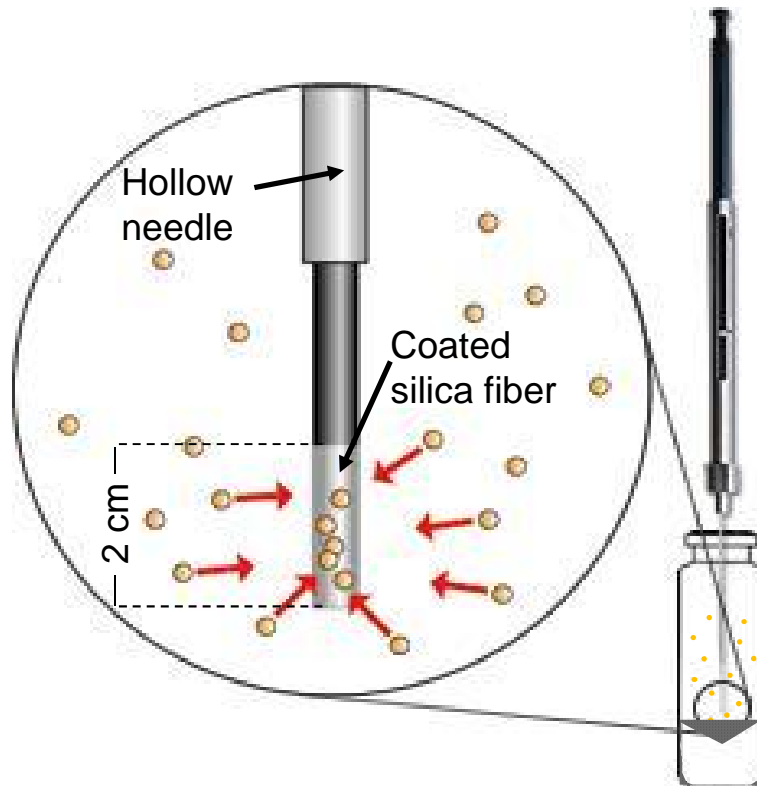


HS-SPME-GC/MS, TIC, heather honey





Headspace Solid-Phase Microextraction (HS-SPME-GC/MS)



Reproducibility: 2.9%

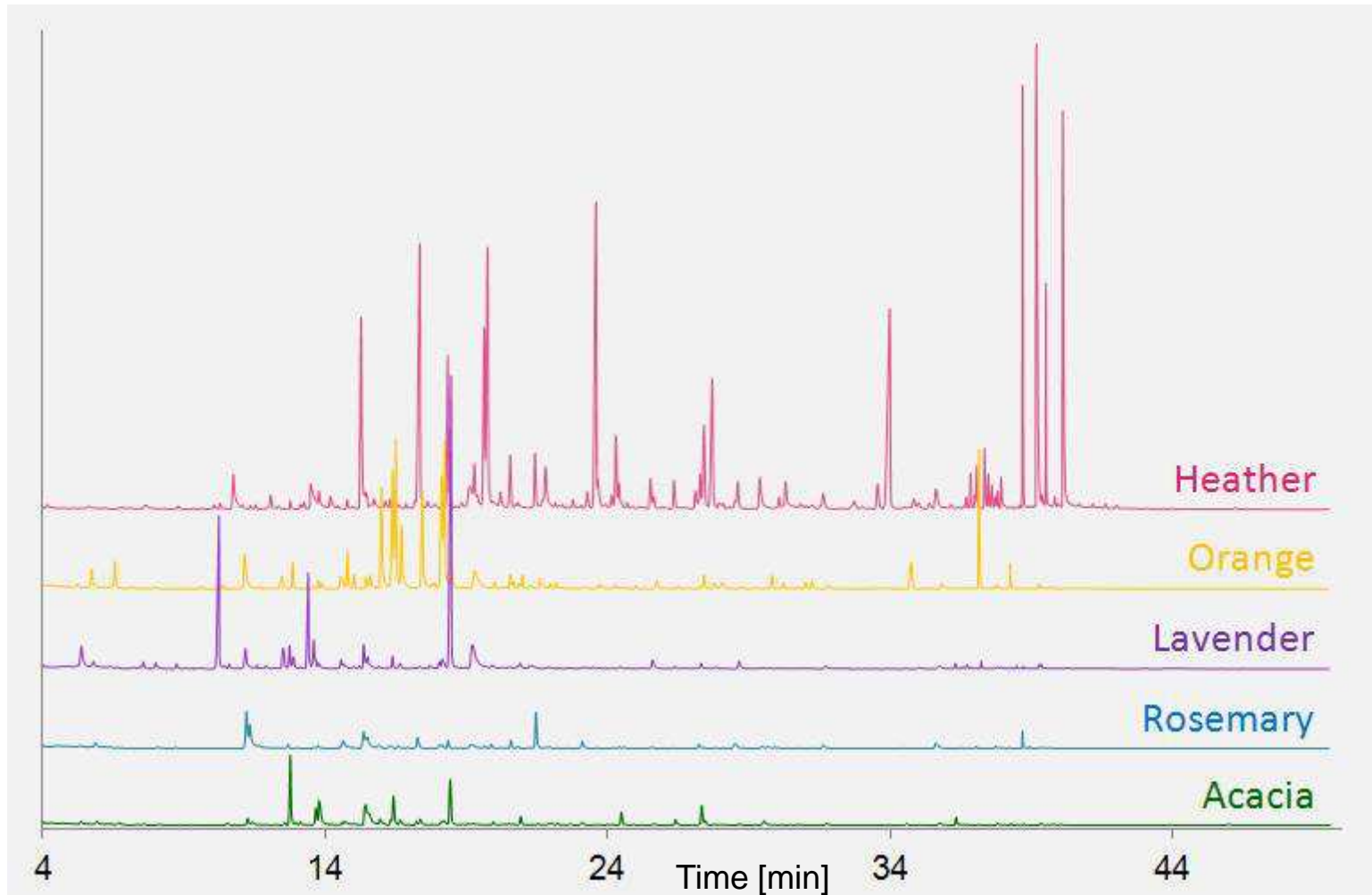
Repeatability: 4.6%

Advantages

- Solvent-free
- Fully automatic
- High sensitivity
- Screening method



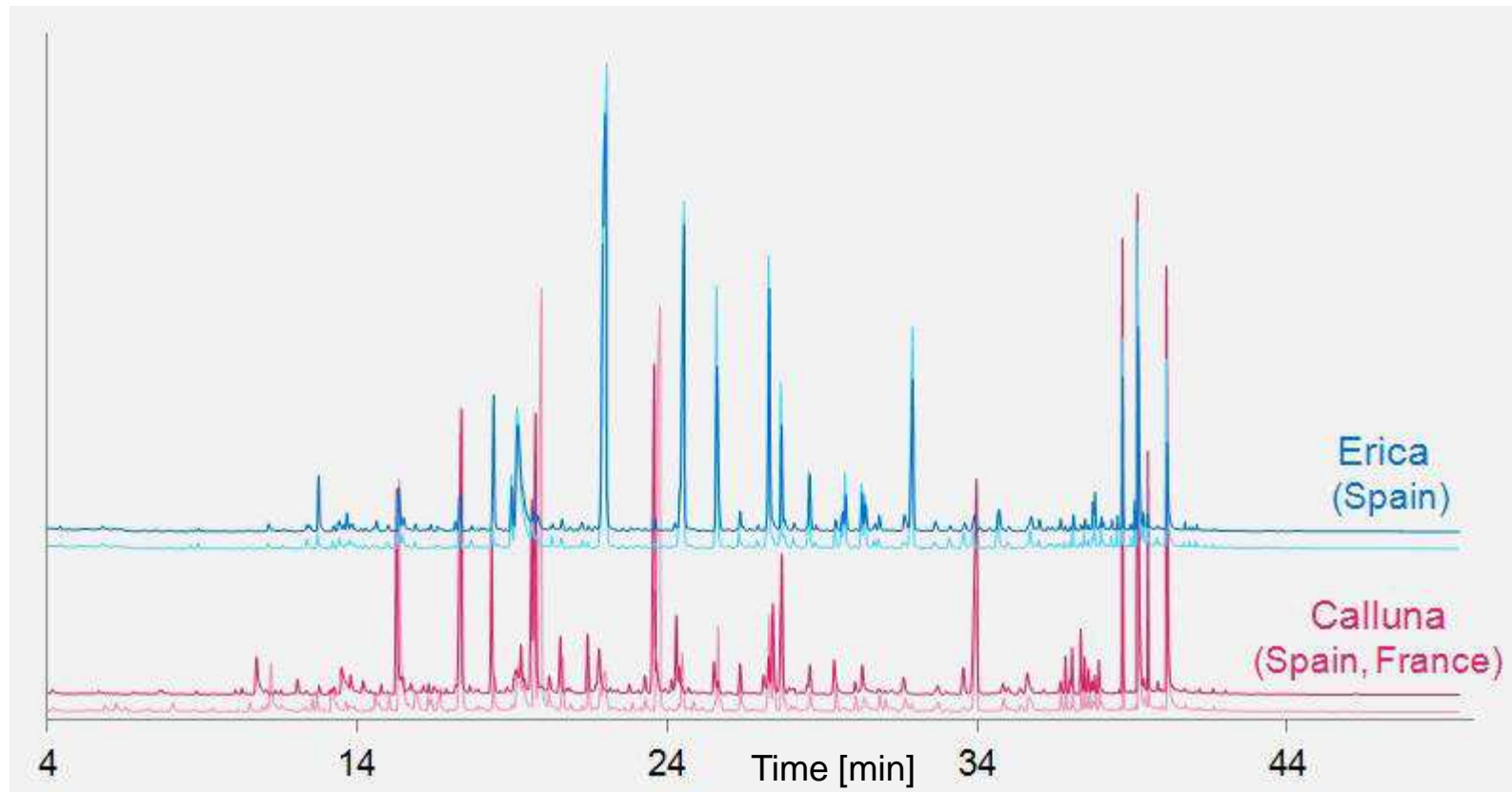
Profile of Different Honeys



HS-SPME-GC/MS, Total Ion Current (TIC)



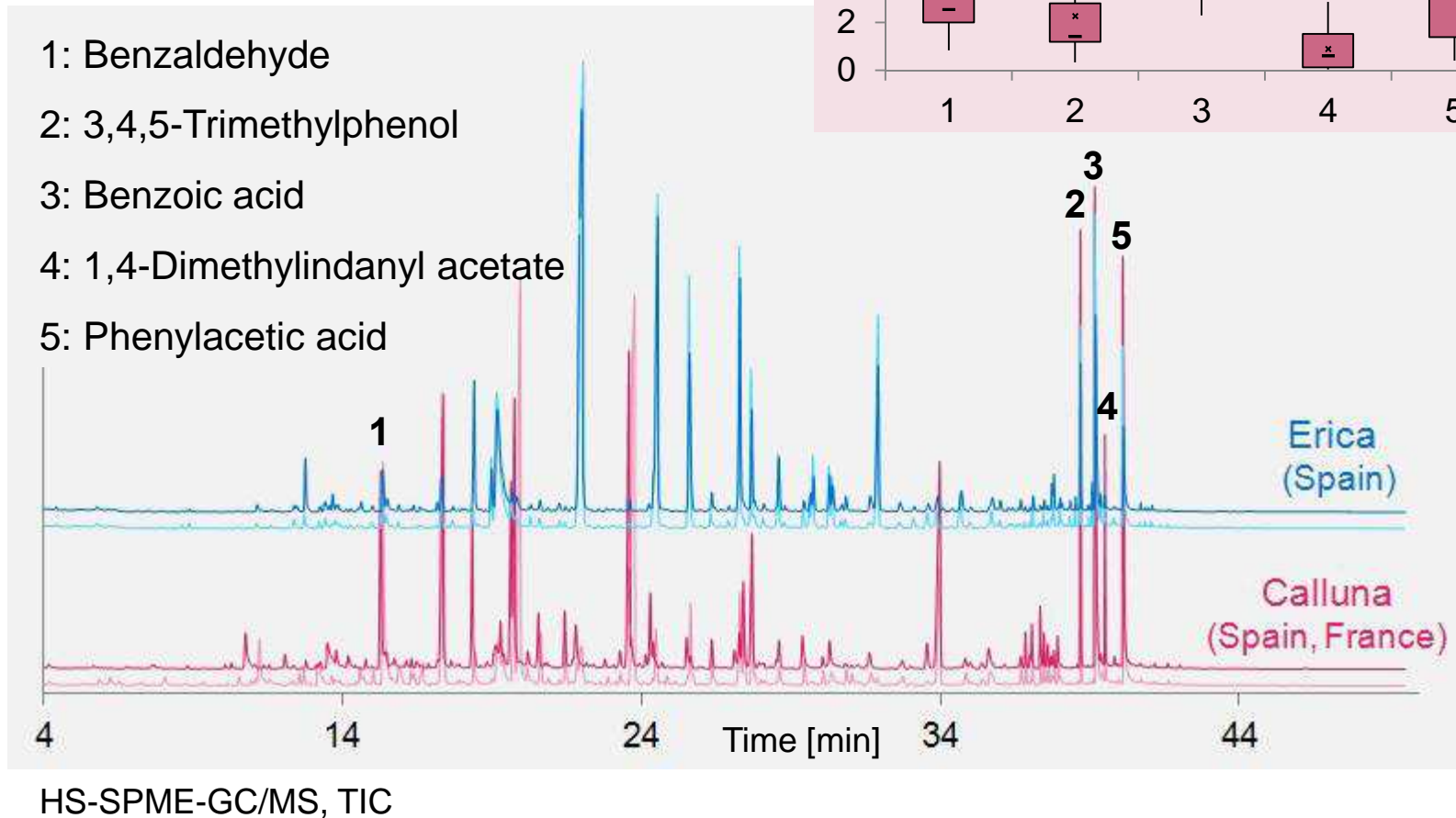
Heather Honeys



HS-SPME-GC/MS, TIC

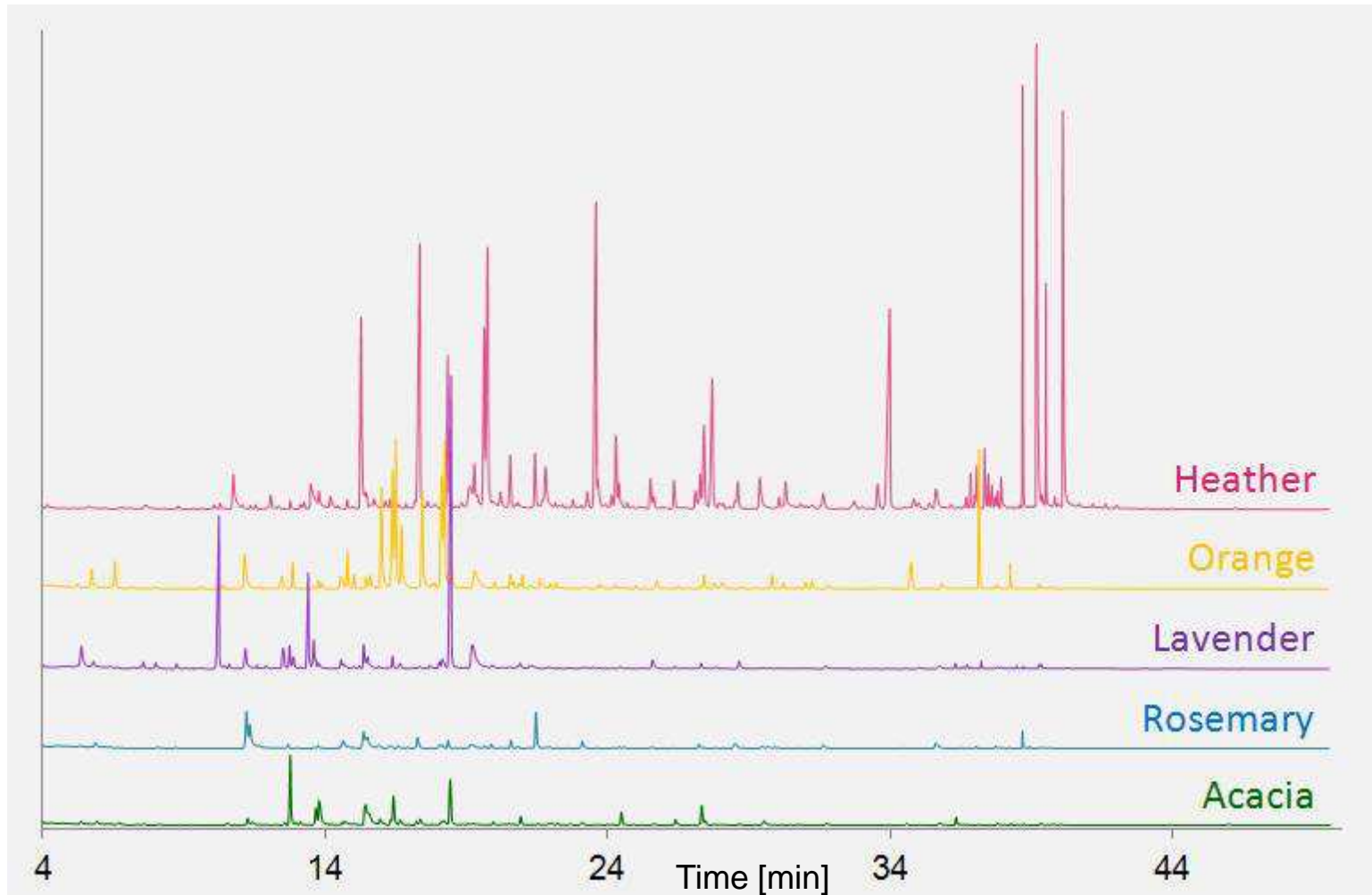


Heather Honeys





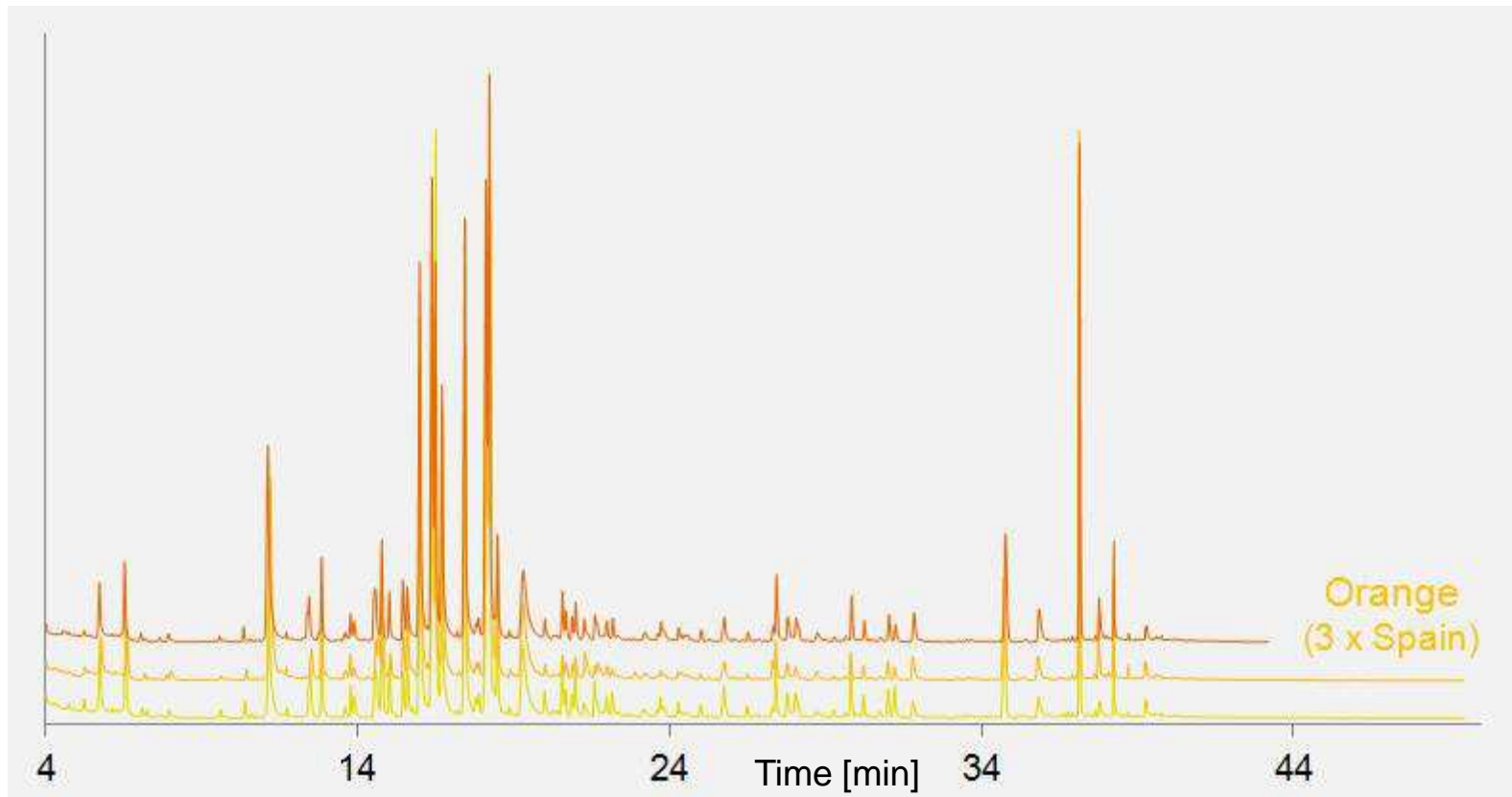
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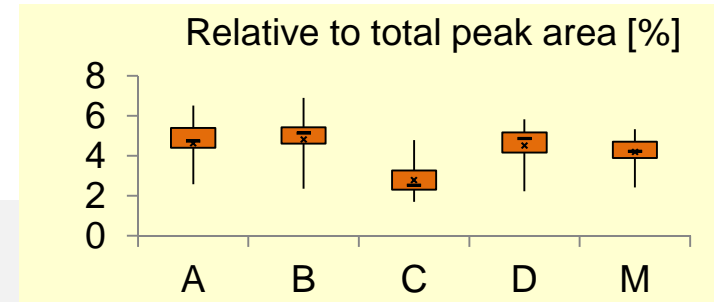
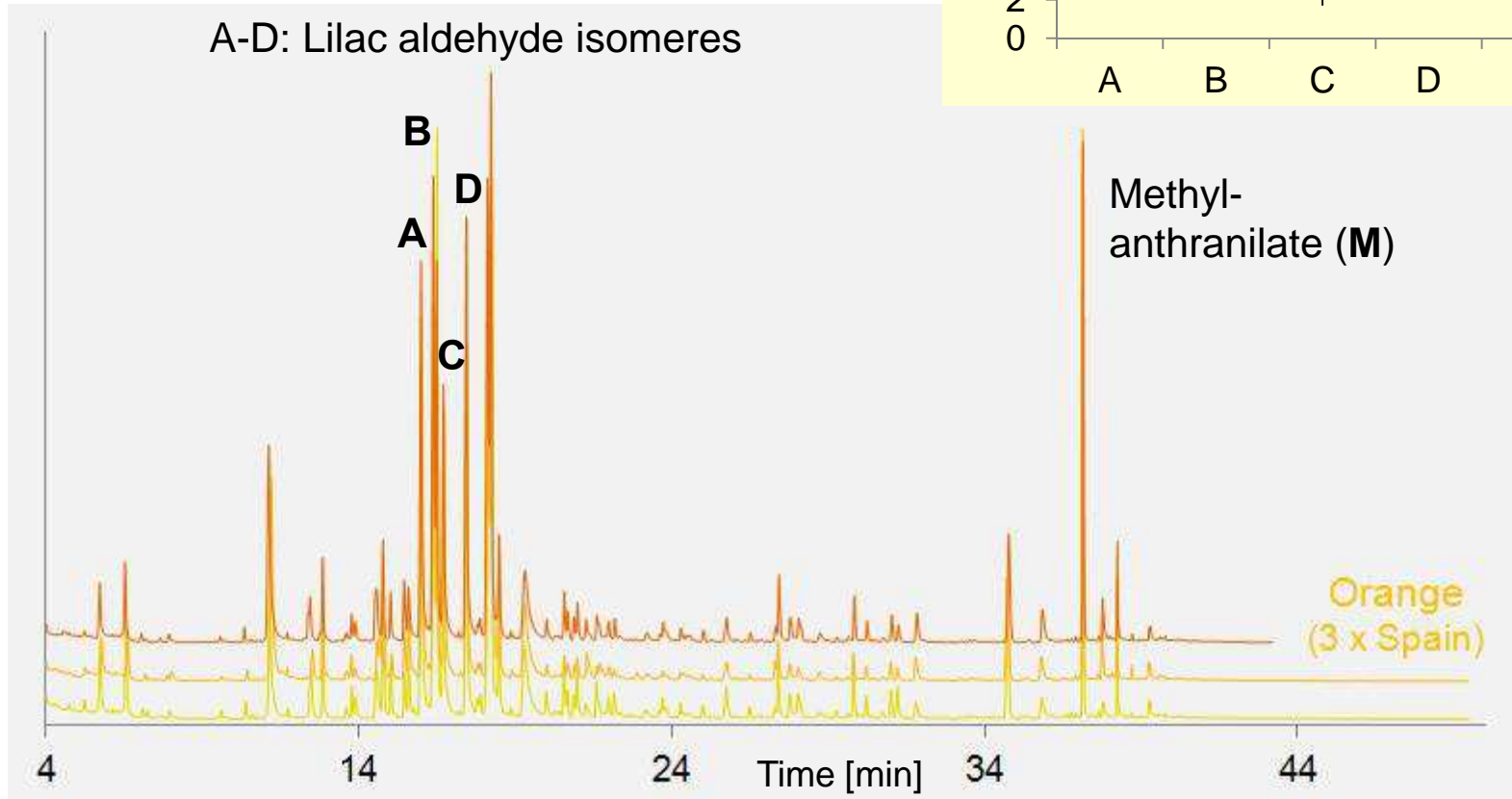
Orange Honeys



HS-SPME-GC/MS, TIC



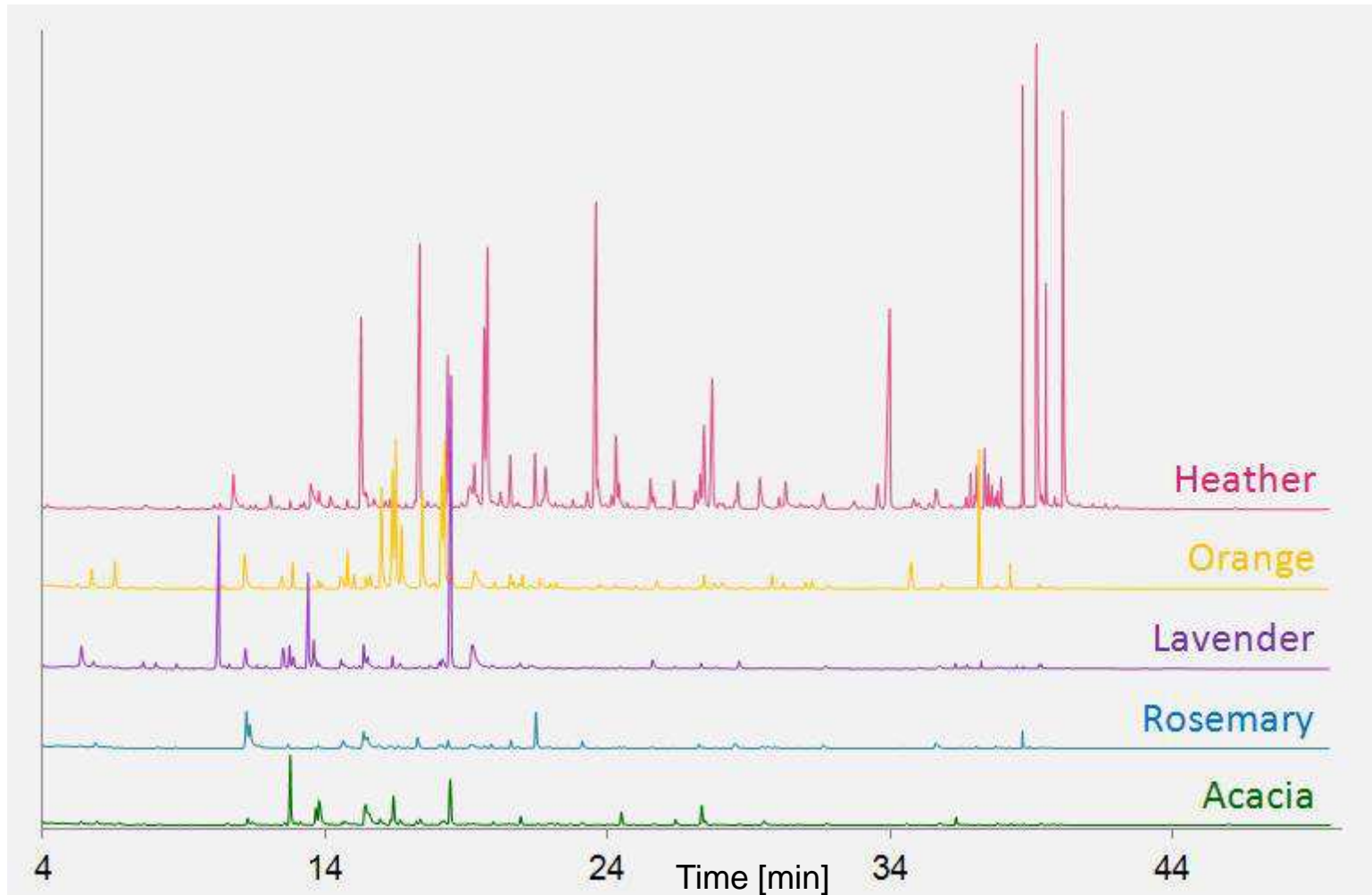
Orange Honeys



HS-SPME-GC/MS, TIC



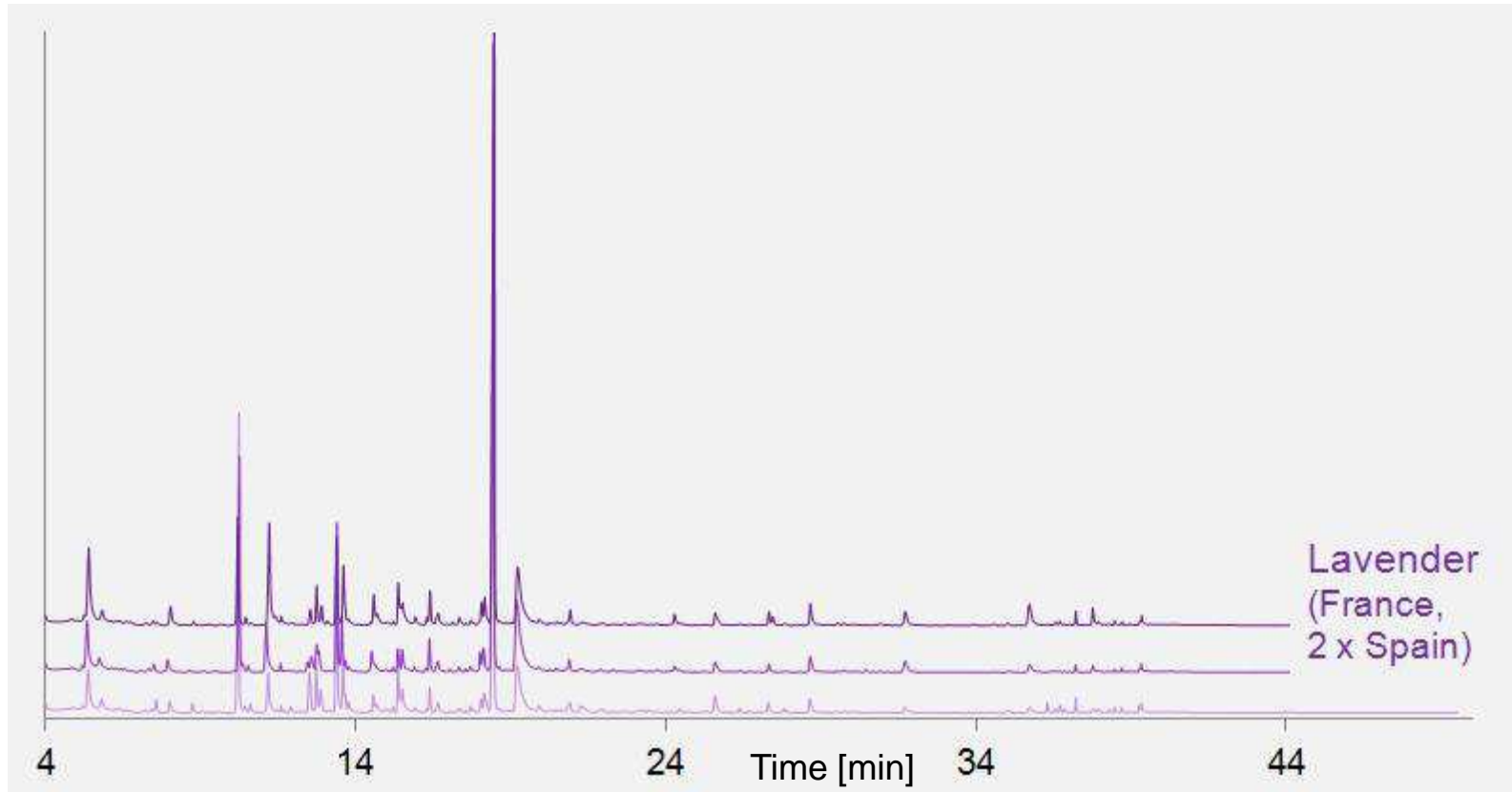
Profile of Different Honeys



HS-SPME-GC/MS, Total Ion Current (TIC)



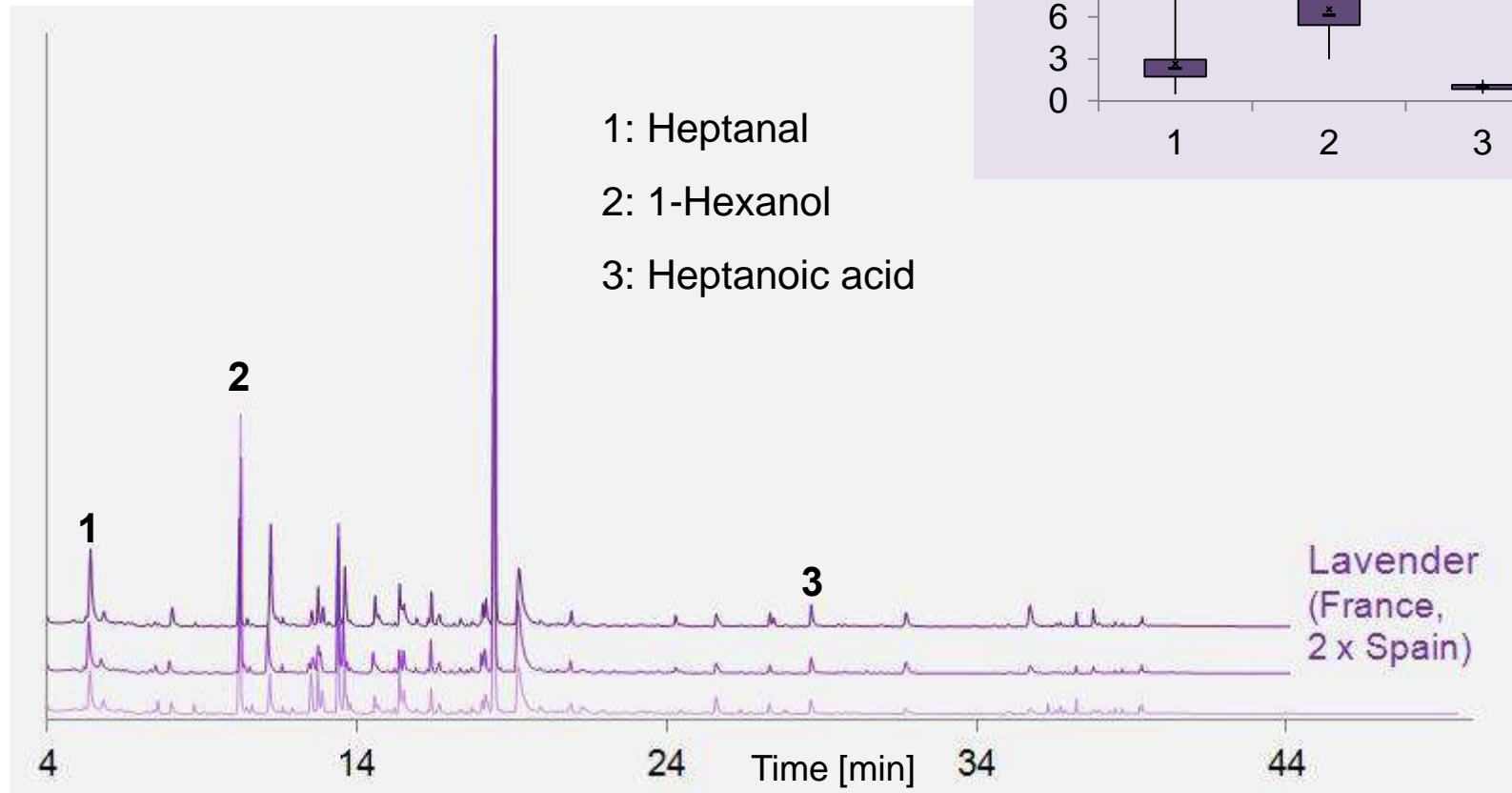
Lavender Honeys



HS-SPME-GC/MS, TIC

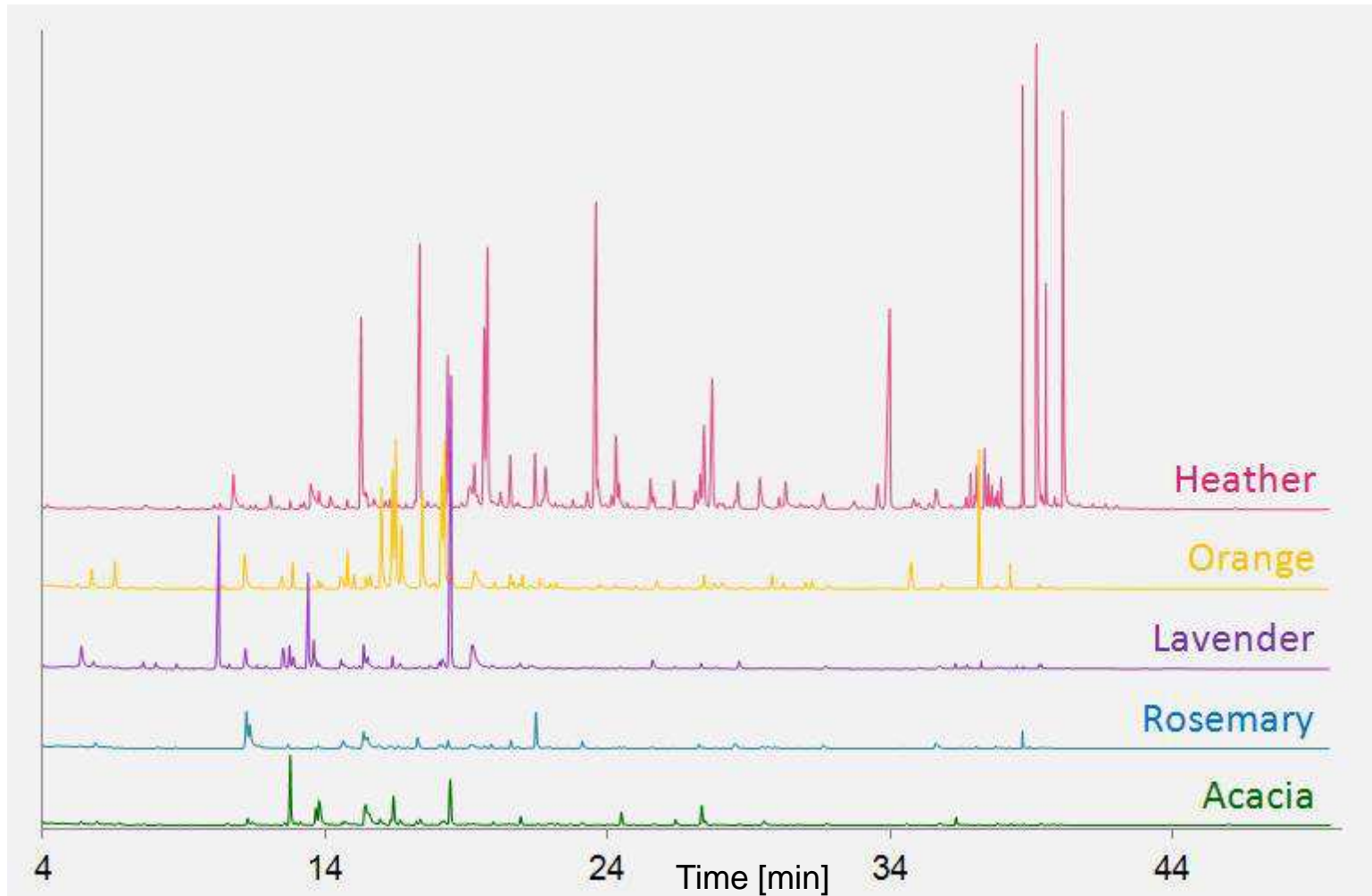


Lavender Honeys





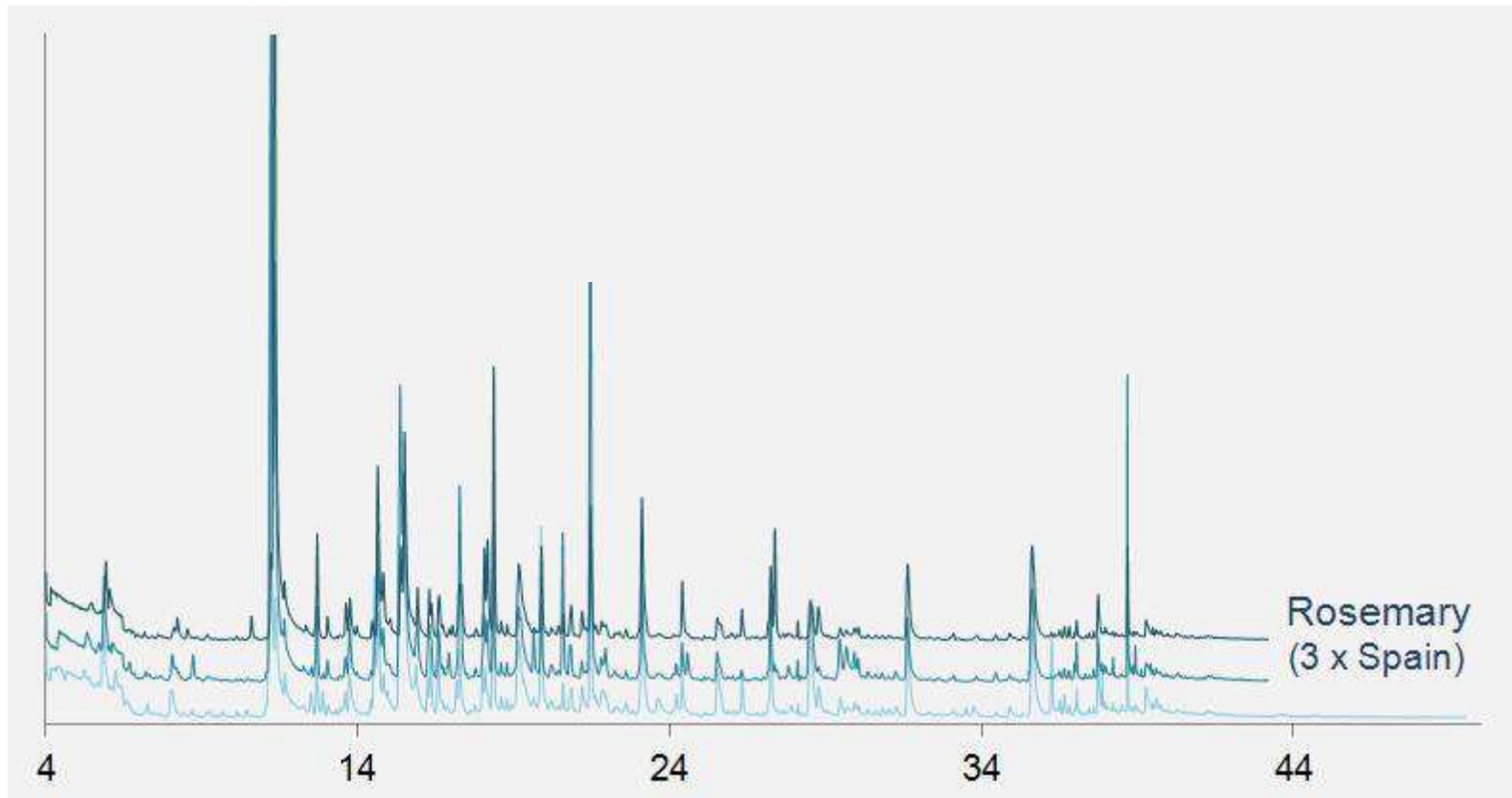
Profile of Different Honeys



HS-SPME-GC/MS, Total Ion Current (TIC)



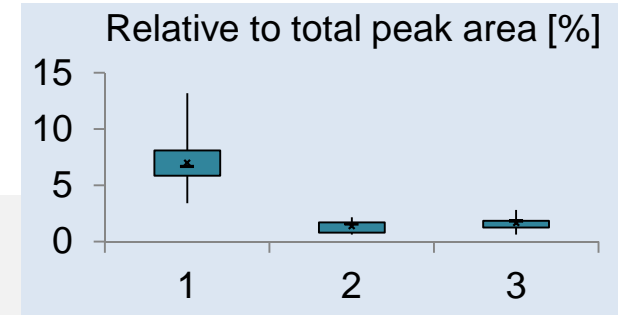
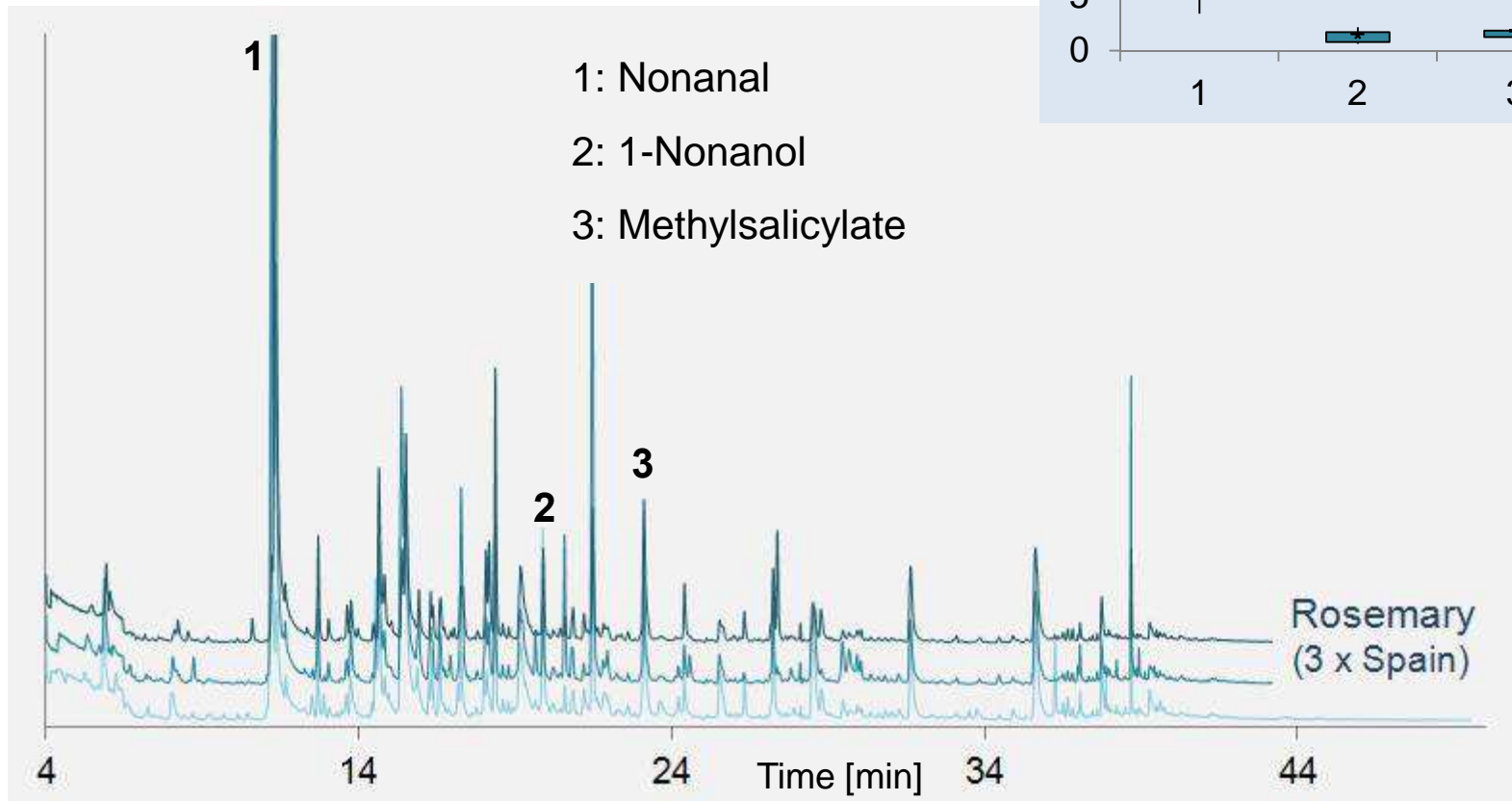
Rosemary Honeys



HS-SPME-GC/MS, TIC



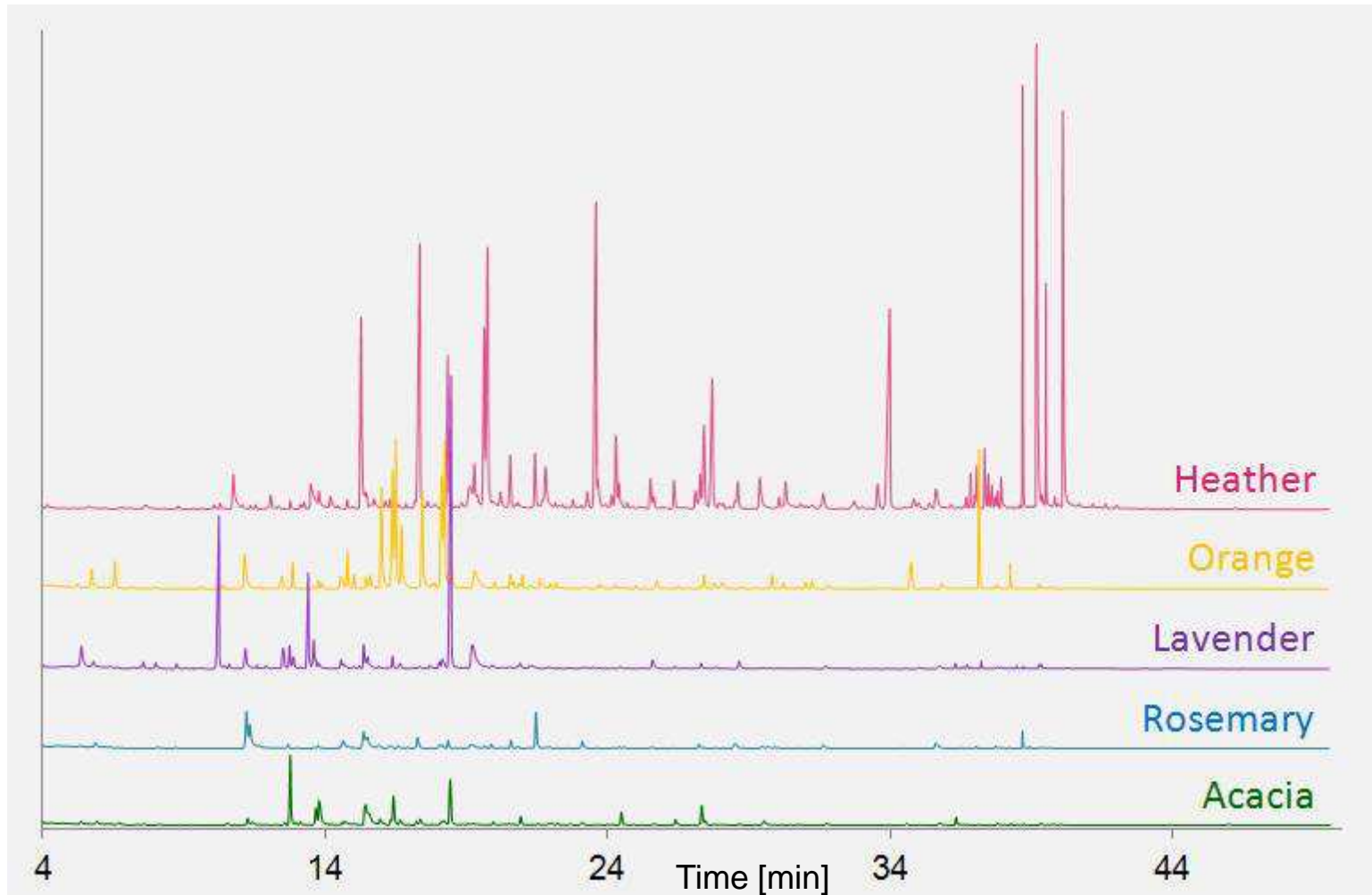
Rosemary Honeys



HS-SPME-GC/MS, TIC



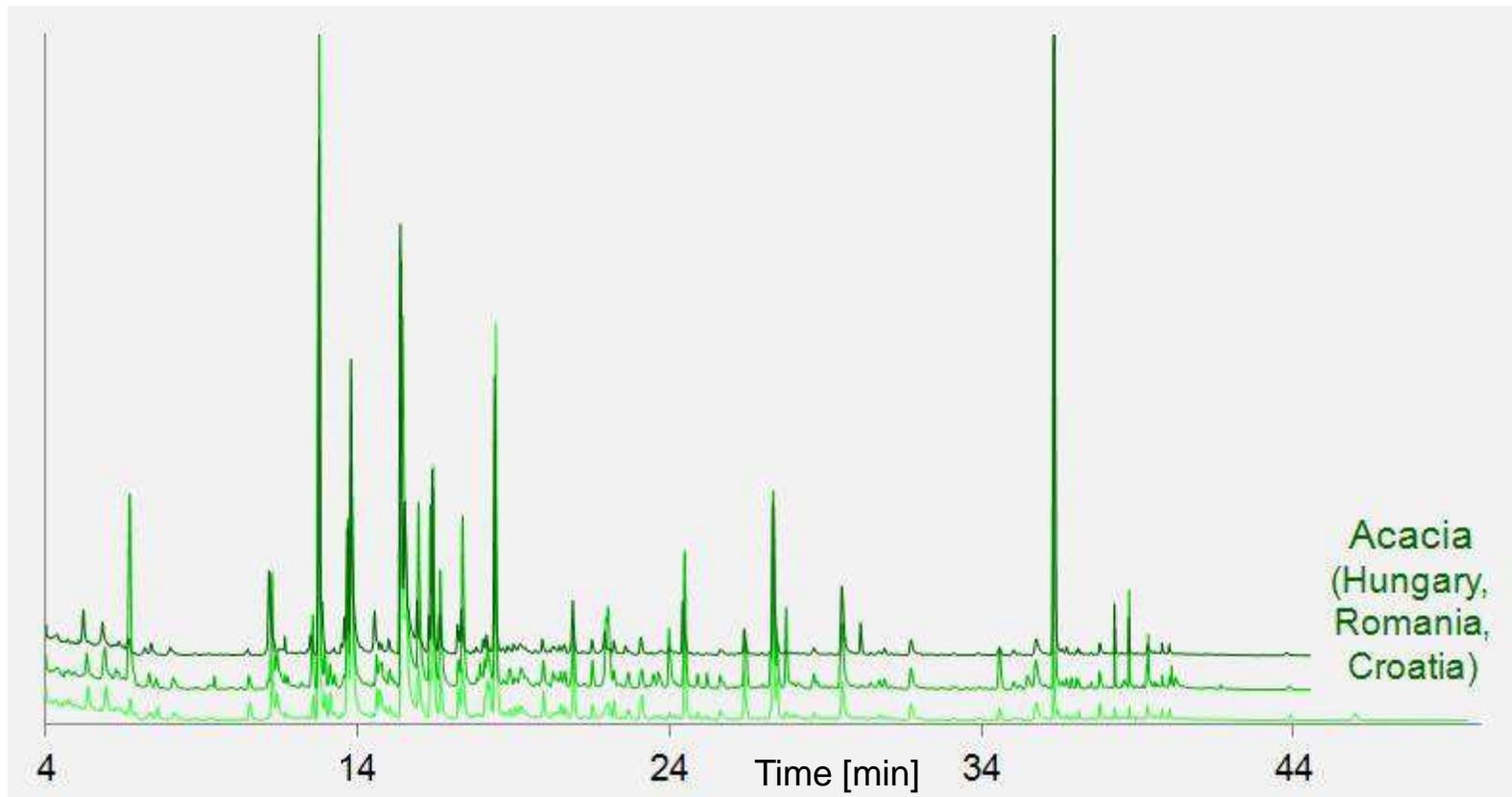
Profile of Different Honeys



HS-SPME-GC/MS, Total Ion Current (TIC)



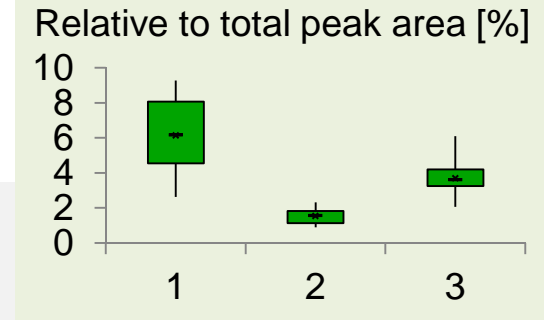
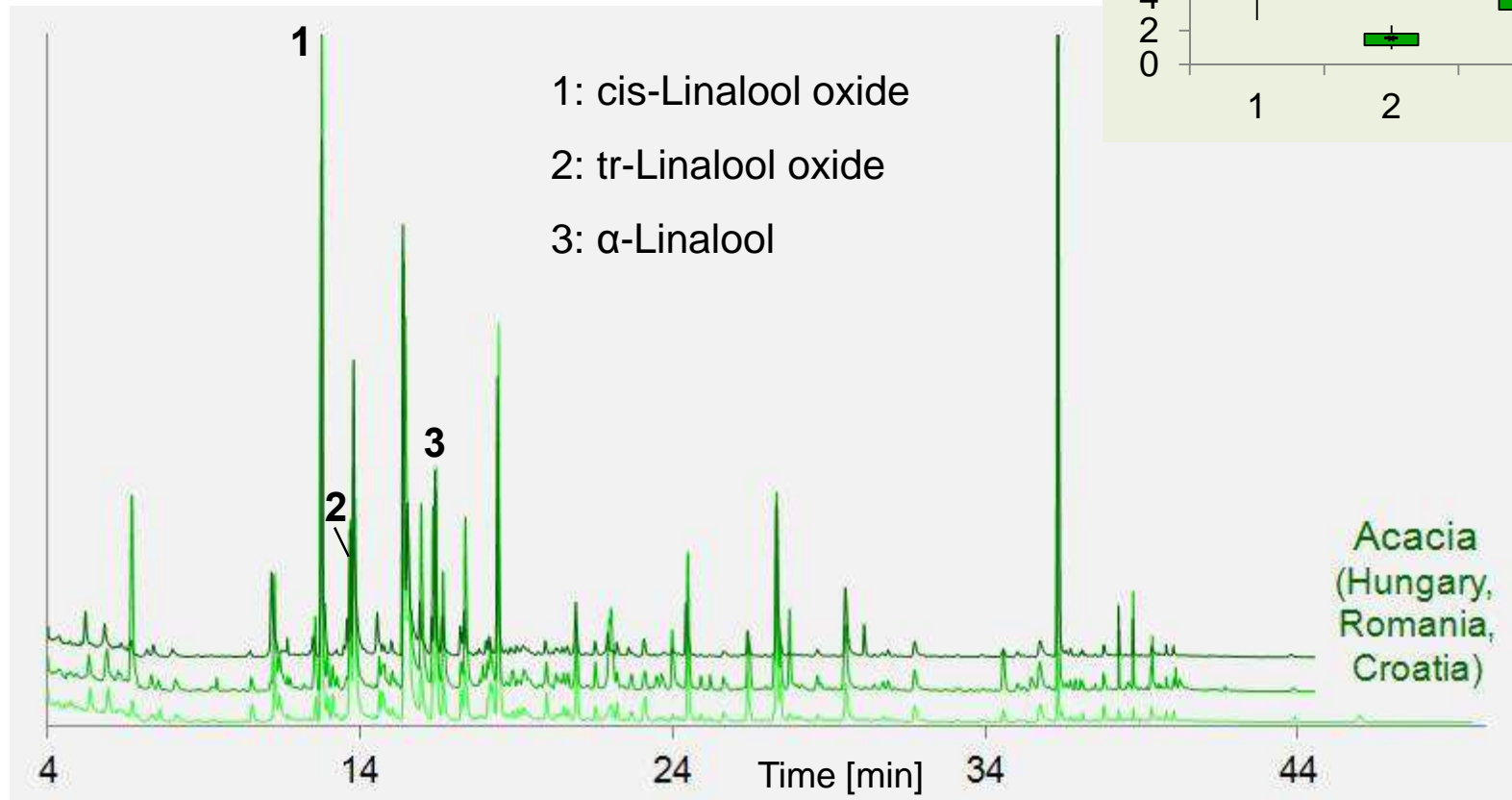
Acacia Honeys



HS-SPME-GC/MS, TIC



Acacia Honeys



HS-SPME-GC/MS, TIC



Specific flavoring compounds indicating the honey sort

Acacia	Lavender	Dandelion	Rosemary
cis-linalool oxide	1-hexanol	2-methylpropanoic acid	nonanal
tr-linalool oxide	heptanal	3-methylbutanoic acid	1-nonanol
alpha-linalool	heptanoic acid	phenylacetonitrile	methylsalicylate
Lime-tree	Manuka	Sage	Sunflower
dimethylstyrol	benzofuran	phenylacetaldehyde	dimethylstyrol
p-cymen-8-ol	dimethylbenzofuran	benzoic acid	cis-linalool oxide
thymol	2'-hydroxyacetophenone	1,4-dimethylindanylacetate	(-)-myrtenol
carvacrol	2'-methoxyacetophenone	phenylacetic acid	octanoic acid
Eucalyptus	Heather	Orange	Chestnut
acetylvaleryl	benzaldehyde	lilac aldehyde A	1-phenylalcohol
n-heptanol	trimethylphenol	lilac aldehyde B	2-aminoacetophenone
nonanal	benzoic acid	lilac aldehyde C	Oregano
nonanoic acid	1,4-dimethylindanylacetate	lilac aldehyde D	p-propylanisole
3-hydroxy-5-methyl-2-hexanone	phenylacetic acid	methylanthranilate	2-methoxy-phenethyl-alcohol
1-nonanol	Thyme	Buckwheat	Pine
2-hydroxy-5-methyl-2-hexanone	thymol	3-methylbutanoic acid	1-chlorooctan
	carvacrol		



Conclusion

Declaration of characteristic flavoring compounds for 16 honey sorts

The HS-SPME-GC/MS profile of manuka and oregano honey was investigated for the first time

Multivariate data analysis is necessary to verify the distinctions

HS-SPME-GC/MS is a useful technique to determine the floral origin of honey sorts



Thanks to

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Dr. Isabelle Kölling-Speer

Prof. Karl Speer

Quality Services International GmbH

numerous honey samples