IDENTIFICATION OF CZECH HOP VARIETIES BY ESSENTIAL OIL ANALYSIS

Kroupa F. - V. F. HUMULUS Ltd., U Odborů 787, 438 01 Žatec 1, Czech Republic
e-mail: kroupa.vfhumulus@seznam.cz

Introduction

Until the early 1990s, Czech hop growing was only focused on the growing of fine aroma hops – Saaz (ŽPČ) variety. In 1994, however, new hop varieties, which were to replace imports of bitter hops from abroad, were registered. At the present time, the range of Czech permitted hop varieties has expanded to a total of 9 varieties – ŽPČ (1952), Bor (1994), Sládek (1994), Premiant (1996), Agnus (2001), Harmonie (2004), Rubín (2007), Vital (2008), and Kazbek (2008). As there has been a considerable extension of the variety structure of hops, it was necessary to find a suitable and relatively quick method for identifying individual hop varieties. The aim of this work was to characterize the content and composition of hop oils in all permitted Czech hop varieties. Based on the knowledge, then, to propose a simple key to the determination of individual hop varieties by the composition of hop oils.

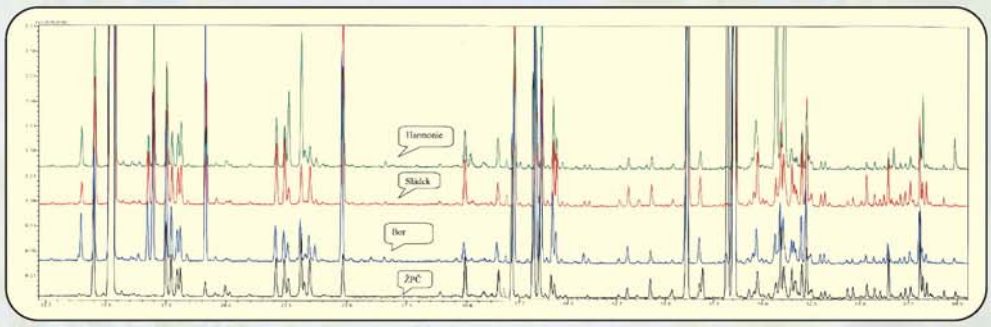

Figure 1 - Example of typical GC-MS chromatograms of the hop varieties

Material and methods

Samples of individual hop varieties were analyzed in 2000-2008. Immediately after being dried, samples of cones were stored at 5°C. The isolation of hop oils was carried out by steam distillation (1). A sample of hop oil for analysis on the GC-MS system was prepared by weighing out of 10 mg of hop oil and its subsequent dilution to 1 ml by n-hexane. 1.5 μl of the sample was injected into the GC-MS system (1). The identification of individual compounds was performed by means of external standards, literary data and, in particular, the PC NIST/EPA/NIH Mass Spectral Library.

GC-MS analysis

Capillary column : DB-5MS, length: 30 m, I. D. 0,25 mm, film 0,5 um
Carrier gas: Helium, 69 kPa
Injector: Split 1:50, T = 230°C
Oven temperature: 60°C,
5 min → 150°C, 2°C/min → 220°C, 5°C/min → 15 min 220°C
Total analysis time: 79 min
Detector: quadrupole mass spectrometer
Ionization mode: EI
Interface temperature: 230°C
Acquisition mode: scan, 35 – 350 m/z

Results

Variety	Volume of oil [ml/100g]	compound (% rel.)																												
		2	3	4	5	7	8	9	10	14	16	17	18	19	21	22	23	24	26	27	30	31								
		Isopentanol	beta-myrcene	2-methyl-butyl-isobutyrate	2-methyl-butyl-isobutyrate	Humulene	2-nonanone	Linalool	octanoic acid, ME	geraniol	4-decanoic acid, ME	methylgeranate	beta-caryophyllene	Isoeugenol	alpha-humulene	beta-farnesene	linalool oxide	alpha-selinene	gamma-selinene	delta-cadinene	caryophyllene oxide	humulene epoxide II								
ŽPČ	0,4 - 1,1	0,62	48,90	-	-	0,17	0,46	0,54	0,29	0,23	1,65	0,15	3,97	0,59	14,12	13,87	0,15	0,22	0,29	0,41	0,09	0,20	1,357	4,00						
Agnus	1,2 - 2,4	1,19	63,87	0,22	2,27	0,35	0,07	0,78	0,36	0,91	1,53	1,96	5,41	-	0,62	0,02	0,28	0,37	0,33	0,48	2,35	0,62	1,39	-						
Bor	0,8 - 2,0	0,92	50,59	0,32	1,31	0,25	0,18	0,43	0,97	0,54	1,80	0,97	6,10	-	21,80	0,14	0,23	0,40	0,41	0,62	1,09	0,28	1,574	-						
Harmonie	1,3 - 2,1	0,90	63,15	0,13	0,63	0,21	0,24	0,97	0,48	0,29	1,48	0,57	3,73	-	10,97	0,02	2,94	3,14	0,26	0,41	5,11	0,28	2,501	-						
Sládek	1,0 - 2,2	0,95	55,69	0,22	0,91	0,24	0,29	0,41	0,96	0,49	1,48	0,92	8,46	-	17,50	0,07	0,24	0,48	0,44	0,67	3,27	0,61	2,709	-						
Premiant	1,4 - 2,4	0,92	58,23	0,29	1,47	0,22	0,29	1,04	0,50	0,31	1,65	0,63	4,87	0,03	16,67	0,65	0,28	0,28	0,33	0,52	1,09	0,25	1,424	0,13						

Table 1 - Evaluation of essential oils in hops (GC-MS)

Table 1 captures the characteristic components of hop oil that were selected for the identification of individual hop varieties. For the period monitored, the average contents of individual selected components of hop oil were determined.

Figure 1 captures example of typical GC-MS chromatograms of the hop varieties ŽPČ, Sládek, Bor, and Harmonie. Individual differences in the composition of hop oils and especially the unique composition of the ŽPČ, which significantly differs from the other hop varieties, can be very well seen there.

Figure 2 captures the proposed key to the determination of Czech hop varieties on the basis of analysis of hop oils.

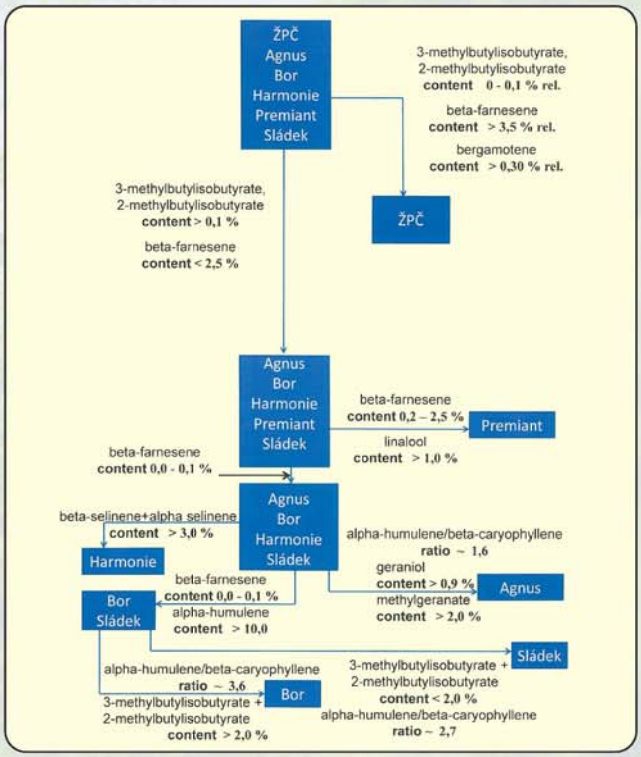

Figure 2 - Key to the Identification of Czech Hop Varieties

Conclusion

- The possibility of identification of individual varieties of Czech hop has been examined.
- Although the composition of some Czech hop varieties is often similar, compounds of hop oils have been detected the representation of which differs in individual varieties and they can be used for the determination of Czech hop varieties.
- The key to the determination of varieties of Czech hops has been proposed.
- This procedure can be applied in business companies and breweries in the control of the quality and variety authenticity of supplied hops.

References

1) Kroupa F. - Dissertation - Objective characterization of hop aroma of Czech hop varieties and hop products, Institute of Chemical Technology, 2007, Prague