

Humulus lupulus L. analysis and comparison of Volatile of spontaneous and commercial varieties: phytotherapeutic potentialities

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Table 1. Composition of the volatile fraction from samples of *Humulus lupulus*

Compostos	RI	Nugget flower	Sample 3	Cascade	Chinouke
Isobutyl isobutyrate	909	0.1			
Methyl hexanoate	914		t		
α -Pinene	930	0.2	0.2		
Camphene	938	t	t		
β -Pinene	963	1.0	0.7	0.8	0.8
β -Myrcene	975	74.8	64.4	67.5	61.3
α -Phellandrene	995	t			
Isoamyl isobutyrate	999	0.2			
β -Phellandrene	1005	0.3	0.2	0.3	
Limono	1009	0.3	0.2	0.2	0.2
<i>cis</i> - β -Ocimene	1017	0.1			
<i>trans</i> - β -Ocimene	1027	0.3		0.1	
γ -Terpinene	1035	t			
2-Nonanone	1058		0.7		
Nonanal	1073	t	0.2		
Linalool	1074	0.3	0.7	0.5	0.3
Methyl octanoate	1105	0.2	0.2		0.1
Hexyl isobutyrate	1127	t			
α -Terpineol	1159	t			
2-Decanone	1166		0.5		
Methyl nonanoate	1205	0.1	0.1		
Heptyl isobutyrate	1233	t			
2-Undecanone	1275	0.2	2.2	1.3	
Methyl decanoate	1314	0.1	t		
α -Ylangene	1371	0.1			0.1
α -Copaene	1375	0.1	t		0.3
2-Dodecanone	1389	t	0.3		
β -Caryophyllene	1414	3.5	1.5	3.0	6.2
β -Copaene	1426	0.1		0.1	0.5
Aromadendrene	1428		0.4		
α -Humulene	1447	12.1	0.2	4.9	12.5
<i>trans</i> - β -Farnesene	1455		8.5	6.4	
<i>trans</i> -Cadina-1(6),4-diene	1469	0.1			
γ -Murolene	1469	0.2	0.6	0.4	1.1
β -Selinene	1476		1.7		0.6
Valencene	1484		2.2		
Viridiflorene	1487		t		
γ -Cadinene	1500	0.3	0.2	0.4	1.1
7- <i>epi</i> - α -Selinene	1500		0.2		
δ -Cadinene	1505	0.5		0.3	1.6
α -Calacorene	1525	t			
α -Cadinene	1529	t			
Germacrene B	1533		1.1		0.7
β -Caryophyllene oxide	1561		0.2		0.1
Viridiflorol	1569		0.2		
γ -Eudesmol	1609		0.2		
T-Cadinol	1616		0.2		0.3
β -Eudesmol	1620		0.6		
Intermedeol	1626		0.3		
α -Eudesmol	1634		0.7		
% Identification		95.2	89.6	93.9	81.6
<i>Grouped compounds</i>					
Monoterpene hydrocarbons		77.0	65.7	75.6	38.8
Oxygen-containing Monoterpenes		0.3	0.7	0.3	0.2
Sesquiterpene hydrocarbons		17.0	16.6	17.7	41.6
Oxygen-containing Sesquiterpenes		t	2.4	0.0	0.9
Others		0.9	4.2	0.3	0.2

RI - Retention index relative to *n*-alkanes C₉-C₁₇; t - trace amount (<0.05%)

Introduction

Humulus lupulus L. is a species of the Cannabaceae family. Hop, as it is commonly known, is a perennial, dioecious and normally diploid (2n = 20) herbaceous plant [1]. It is in the beer production that hops have their greatest economic value at the international level. Hop can be seen as a medicinal plant with an array of uses, from the antibacterial compounds for beer conservation [2] to sedative, diuretic and antiarthritic properties [3].

Material and Methods

The spontaneous material was collected from areas of Bragança district. The cultivars were collected from producers fields. The female flowers were used to perform a Likens-Nickerson extraction of the volatile compounds and then analyzed in GC and GC-MS.



Figure 1: female flower Hop, Amplified 10x Figure 2: Hop plant in a Hop garden

Results

The results obtained show a certain similarity in the monoterpene component, with β -myrcene as the major compound (more than 64% in cultivar and spontaneous samples) and notorious differences in the sesquiterpene component, evident in cases of α -humulene (12% in cultivars, 0.2% and in spontaneous) and *trans*- β -farnesene (not detected in cultivars, 9% in spontaneous). Also important, is the richness of the sesquiterpene group in spontaneous clone, in particular in the oxygenated compounds. This profile, of both cultivar and spontaneous, shows potential for antiseptic effects in the digestive tract, especially when these are associated with bacteria such as *Helicobacter pylori* [4], which will be in agreement with ethnobotanical uses of Hop.

- [1] Heale J. B., Legg T., Brar J., Fabb A., Bainbridge B., (1989) Application of plant tissue culture and molecular biology techniques to "progressive" wilt of hops caused by *Verticillium albo-atrum*. Eur. Brew. Conv. Monogr., XV, Symposium on Plant Biotechnology, Helsinki, 70:83.
- [2] Duke, J. A., (1983). *Humulus lupulus* L. Handbook of energy crops.
- [3] José Manuel Neves, Carla M. Matos, Carla G. Moutinho, Lúcia Rebelo Gomes, (2008) Usos populares de plantas medicinais da flora transmontana Revista da Faculdade de Ciências da Saúde. Porto. ISSN 1646-0480. 5 (2008) 226-235.
- [7] Flavia Bonamina, Thiago M. Moraesa, Raquel C. dos Santos, Hélio Kushimaa, Felipe M. Fariab, Marcos A. Silvac, Ivan V. Juniorc, Leonardo Nogueirad, Tais M. Bauabd, Alba R.M. Souza Britob, (2014) Chemo-Biological Interactions Volume 212, 5 April 2014, Pages 11–19.



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