

# IDENTIFICATION OF BIOACTIVE COMPOUNDS IN HYDROSOL AND RESIDUAL WATER AFTER STEAM DESTILATION OF ESSENTIAL OIL CULTURES



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## INTRODUCTION

Steam distillation is a common technological process, which guarantees high and sustainable quality of the extracted oils. As a result of the distillation, in addition to the essential oil and the distilled biomass, there are also two other liquid fractions - hydrosol and residual water. Due to the presence of volatile organic components in the hydrosol and polyphenolic compounds in the residual water they are likely to exhibit antimicrobial and antioxidant activity and their uncontrolled disposal could lead to pollution of surface and groundwater and disturb the ecological balance.

The aim of this study is to gather information about the identification of the main components with biological activity in the hydrosol and the residual water of four plants – Rosa Damascena, Lavender, Lemon balm and Clove. HPLC and GC chromatographic methods will be used to identify and quantify these components. Determination of antioxidant and antibacterial activity will also be performed.

### Rosa Damascena

Table 1. Chemical composition of Rosa Damascena hydrosol and essential oil [1], [%]

Compound	Hydrosol	Essential oil
Citrenellol	29,44	35,23
Nerol	16,12	10,24
Geraniol	30,74	22,19
Phenylethyl alcohol	23,7	2,3

[1] H. Sec, "Tocopherol, Carotene, Phenolic Contents and Antibacterial Properties of Rose Essential Oil, Hydrosol and Absolute," pp. 554–558, 2009, doi: 10.1007/s00284-009-9475-y.

[2] Rusanov, K., Garo, E., Rusanova, M., Fertig, O., Hamburger, M., Atanassov, I., Butterweck, V. (2014) Recovery of Polyphenols from Rose Oil Distillation Wastewater Using Adsorption Resins – A Pilot Study, *Planta Med.* 2014; 80: 1657–1664.

Table 2. Compounds detected in the HPLC-PDA-MS profiles of Rosa Damascena residual water [2], [%]

Compound	Molecular weight [g/mol]
Phenyl-glucopyranoside	284.3
Kaempferol	286.2
Quercetin	302.2
Ellagic acid	302.2
Kaempferol-3-O-glucoside (Astragalin)	448.4
Kaempferol-3-O-glucosylrhamnoside (Multiflorin B)	594.5
Quercetin-3-O-rhamnosylglucoside (Rutin)	610.5
Kaempferol-3-O-acetylglucosylrhamnoside (Multiflorin A)	636.5
Flavonol trisaccharide	786.7
Pectin	> 30 000

### Lavender

Table 3. Chemical composition of Lavender hydrosol and essential oil [3], [%]

Compound	Hydrosol	Essential oil
Linalool	45,0	34,1
Camphor	15,7	10,2
1,8-Cineole	14,8	18,5
α-Terpineol	11,8	2,2
Borneol	11,3	14,5
trans-Linalool oxide	0,2	-
cis-Linalool oxide	0,2	-
Acetophenone	<0,05	-

Table 4. Compounds detected in the HPLC-PDA-MS profiles of Lavender residual water [4], [%]

Compound	Molecular weight [g/mol]
Rosmarinic acid	360,3
Luteolin	286,2
Caffeic acid	180,2
Pectin	> 30 000

[3] Afsharypour S, Azarbayejany N (2006). Chemical Constituents of the Flower Essential Oil of *Lavandula officinalis* Chaix. from Isfahan (Iran), *Iranian J. Pharma. Sci.*, 2(3): 169-172.

[4] Laura Torras-Claveria, Olga Jauregui, Jaume Bastida, Carles Codina, and Francesc Viladomat (2007) Antioxidant Activity and Phenolic Composition of Lavandin (*Lavandula x intermedia* Emeric ex Loiseleur) Waste, *J. Agric. Food Chem.*, 55, 8436–8443.

### Lemon balm

Table 5. Chemical composition of Lemon balm hydrosol and essential oil [5], [%]

Compound	Hydrosol	Essential oil
Citral (neral+geranial)	25,0	0,96 - 43,0
Geraniol	30,42	3,4 - 12,38
Germacrene D	-	2,4 - 3,8
β-caryophyllene	-	4,6 - 12,3
Citronellol	1,92	3,5 - 8,23
Citronellal	-	3,7 - 4,5
Limonen	-	2,2
β-caryophyllene	-	1,7
Linalool	3,0	0,8 - 14,21
trans-p-ment-2-ene-1,8-diol	2,625	-
cis-p-ment-2-ene-1,8-diol	2,33	-

Table 6. Compounds detected in the HPLC-PDA-MS profiles of Lemon balm residual water [6], [%]

Compound	Molecular weight [g/mol]
Rosmarinic acid	360,3
Rutin	610,5
Caffeic acid	180,2
Pectin	> 30 000

[5] Garneau, F.X., Collin, G. and Gagnon, H., 2014. Chemical composition and stability of the hydrosols obtained during essential oil production. I. The case of *Melissa officinalis* L. and *Asarum canadense* L. *Am. J. Essent. Oils Nat. Prod.*, 2, pp.54-62.

[6] Aleksandra Sentkowska, Magdalena Biesaga, and Krystyna Pyrzynska (2015) Polyphenolic Composition and Antioxidative Properties of Lemon Balm (*Melissa officinalis* L.) Extract Affected by Different Brewing Processes. *International Journal of Food Properties*, 18:2009–2014, DOI: 10.1080/10942912.2014.960932.

### Clove

Table 7. Chemical composition of Clove hydrosol and essential oil [7], [%]

Compound	Hydrosol	Essential oil
Eugenol	80,8	74,28
Eucalyptol	8,7	5,78
Caryophyllene	-	3,85
Camphor	6,7	-
α-cadinol	-	2,43
Borneol	1,1	-
Varbenone	1,1	-
Limonen	-	2,08

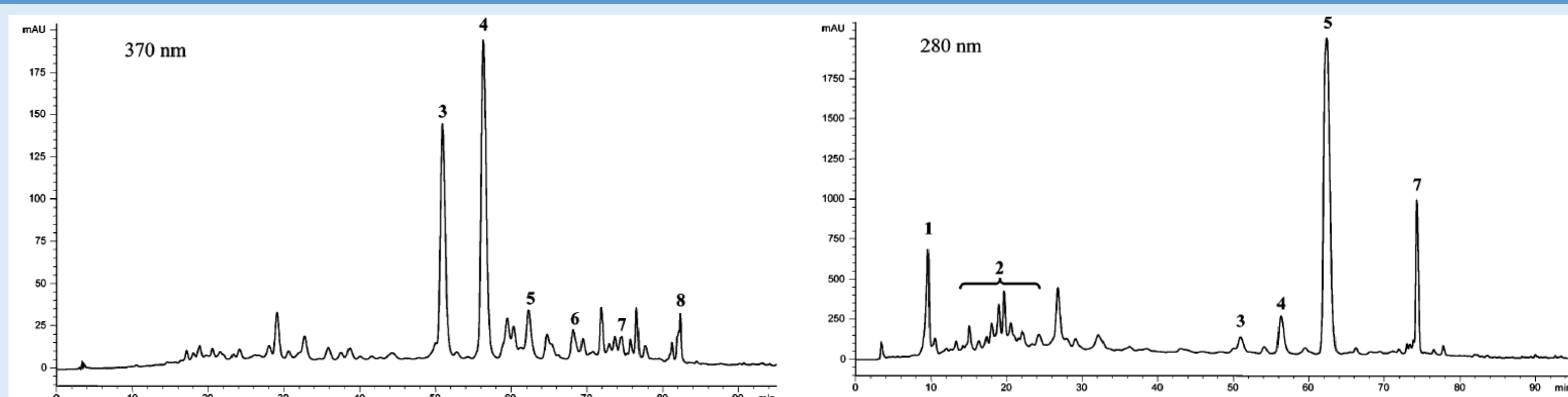


Figure 1. HPLC-DAD profiles of Clove residual water [8] at 280 and 370 nm. 1) gallic acid; 2) tannin constituents; 3) and 4) flavonol glucosides; 5) eugenol; 6) quercetin; 7) acetyl eugenol; and 8) kampferol

[7] Bhuiyan, M. N. I., Begum, J., Nandi, N. C., & Akter, F. (2010). Constituents of the essential oil from leaves and buds of clove (*Syzygium caryophyllatum* (L.) Alston). *African Journal of Plant Science*, 4(11), 451-454.

[8] Diego Francisco Cortés-Rojas, Claudia Regina Fernandes de Souza, Wanderley Pereira Oliveira (2014) Clove (*Syzygium aromaticum*): a precious spice. *Asian Pac J Trop Biomed* 4(2), 90-96.

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