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Antiradical Activity of Hop (*Humulus Lupulus L.*) Cone Extracts

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Various extracts of hop (*Humulus Lupulus L.*) cones have been studied due to their anticancer [1], antioxidant, antiviral and antibacterial [2], antiradical, antiradiation [3] etc. activity. Potential antioxidants found in hop cones are bitter acids [1], polyphenols, substituted benzoic and cinnamic acids [4], derivatives of humulone and lupulone [2].

The aim of our study was the investigation of impact of extraction method on both the yield of extract and total amount of polyphenols (TAP), as well as free radical scavenging activity (FRSA; expressed as concentration IC₅₀, which is necessary to inhibit 50% of DPPH). The extraction was carried out by maceration of hop cones in the extrahent for 24 hrs in dark (method A) or by variable duration ultrasonic treatment (method B). The results obtained (30 min extraction in case of extracts prepared by method B) are presented in Table 1.

increase the yield of extracts and TAP in comparison with method A. The yield of extracts and TAP are less dependent from method of extraction in case of nonpolar solvents.

In order to find out IC₅₀ value, we tested various concentrations of each extract for free radical scavenging activity. We have established that high polarity extracts exhibit strong antioxidant-prooxidant effect. Slight changes of FRSA were observed for medium polarity extracts at higher concentrations. Linear correlation between concentration of the extract and FRSA was revealed for nonpolar extracts of hop cones.

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2. Yamaguchi, N., Satoh-Yamaguchi, K., Ono, M. *In vitro* Evaluation of Antibacterial, Anticollagenase, and Antioxidant Activities of Hop Components (*Humulus lupulus*) Addressing *Acne Vulgaris*. *Phytomedicine*, 2009, vol. 16, p. 369-376.
3. Malakyan, M. H., Bajinyan, S. A., Vardevanyan, L. A., et al. Anti-radiation and Anti-radical Activity of Hydroponically Produced Hop Extract. *In: ISHS Acta Horticulturae 848: II International Humulus Symposium*; Ghent, 2009, <http://www.actahort.org/books/848/>.
4. Magalhaes, P. J., Vieira, J. S., Goncalves, L. M., et al. Isolation of Phenolic Compounds from Hop Extracts using Polyvinylpyrrolidone: Characterization by High-Performance Liquid Chromatography-Diode Array Detection-Electrospray Tandem Mass Spectrometry. *Journal of Chromatography A*, 2010, vol. 1217, p. 3258-3268

Table 1
Characterization of hop cone extracts

Extrahent	Method of extr.	Yield, %	TAP, %	IC ₅₀ , mg/ml
Water	A	11	4.3	-
	B	13	5.1	-
Ethanol	A	22	5.6	6.8
	B	24	9.4	1.8
Acetone	A	15	5.1	3.4
	B	18	5.7	3.9
Ethyl acetate	A	11	4.5	0.5
	B	12	5.1	3.1
Toluene	A	11	3.1	1.4
	B	11	2.9	0.7
Hexane	A	10	3.4	0.4
	B	6	3.1	-

We have established that extraction with polar solvents according to method B