CHEMICAL COMPOSITION AND ANTIFUNGAL ACTIVITY OF ESSENTIAL OILS OBTAINED FROM ABIES SIBIRICA L., GROWING IN THE REPUBLIC OF KAZAKHSTAN

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Basing on the analysis of literature it was revealed that a comprehensive study of etheric-oil plants, essential oils and search for ways of their new applications in various sectors of the economy are not only urgent in this century, but are also acquiring a special importance, scientific and practical significance. Among coniferous attar plants the most widely spread in the Republic of Kazakhstan is Abies sibirica L., which grows in the East Kazakhstan region, mountain forests of the Altai, the Tarbagatai and the Dzhungarsky Alatau. The aim of this work is the comparative research of the component composition of the essential oils samples obtained by means of steam distillation and microwave heating from Abies sibirica L., collected in the Altai mountain forests of the East Kazakhstan region, and their antifungal activity towards Candida albicans.

Keywords: essential oils, microwave heating, antifungal activity

Basing on the analysis of literature it was revealed that a comprehensive study of etheric-oil plants, essential oils and search for ways of their new applications in various sectors of the economy are not only urgent in this century, but are also acquiring a special importance, scientific and practical significance [1]. Among coniferous attar plants the most widely spread in the Republic of Kazakhstan is Abies sibirica L., which grows in the East Kazakhstan region, mountain forests of the Altai, the Tarbagatai and the Dzhungarsky Alatau [2–3].

Many authors [works 4–11] have studied the component compositions of the essential oils, obtained by different methods from Abies sibirica L. But their works do not fully represent the component composition of the essential oil obtained from Abies sibirica L. by microwave heating. Antimicrobial activity of the fir oils obtained by steam distillation is also represented [works 12–17], but antifungal activity of the essential oil of Abies sibirica L. obtained by microwave heating has not been studied.

The Objective. The aim of this work is the comparative research of the component composition of the essential oils samples obtained by means of steam distillation and microwave heating from Abies sibirica L., collected in the Altai mountain forests of the East Kazakhstan region, and their antifungal activity towards Candida albicans.

The Object and Methods. The raw material was analyzed fresh. To avoid destruction of biologically active substances and to remove excess moisture it was dried immediately after gathering. [18]. Samples of the essential oils of Abies sibirica L. were obtained by methods of steam distillation and microwave heating in a «STARTE Microwave Extraction System» device.

Qualitative and quantitative analyses of the essential oils samples composition were performed with an «Agilent Technologies 7890A GC System, 7683B Series Injector, 5975C VL MSD with Triple-Axis Detector» device. To identify the components the library of NIST 02 and Willey mass spectra was used. Table represents the component structure of the fir essential oil of Abies sibirica L., obtained by microwave heating.

For the study of the antifungal activity of the essential oils of Abies sibirica L. reference strains of Candida albicans were received from the laboratory of the Department of Infectious Diseases and Microbiology of the Veterinary and Pharmaceutical University in Brno, Czech Republic. Oils samples were dissolved in DMSO and 0,9 % saline solution. After dissolution the essential oils samples were placed into 96-well flat microplates [19–21].

For the testing the fungal inoculum was resuspended with a multichannel pipette to achieve a final volume of 100 micro liters. The highest concentration of the oil solution is 256 mkg/ml. 5-Flucytosine (1 mkg/ml) was included as a positive control. Candida albicans growth was monitored by measuring the optical density at 600 nm in a microplate reader (BMG, reader Labtech, Germany) at 37°C from 0 to 48 hours. The monitoring conducted within 48 hours showed that the essential oil of Abies sibirica L., obtained by means of microwave heating, has the highest antifungal activity next to the positive control 5-Flucytosine. (Figure).

The antifungal activity of the essential oils of Abies sibirica L., obtained by means of steam distillation (sample WM) and microwave heating (sample MW), was determined with a «SPECTRO star Omega» device. The results of the study are shown below in Figure.

Chemical composition of the essential oil of Abies sibirica L., obtained by microwave heating

Composition	R_t	%	Composition	R_t	%
Santene	9,05	5,63	Bornylacetate	31,12	34,26
Tricyclene	9,87	1,57	β -Caryophyllene	31,76	0,57
α-Pinene	10,46	10,03	Unknown with Mr 204	33,25	0,27
Camphene	12,26	18,16	Unknown with Mr 204	33,58	0,05
β-Pinene	13,90	1,34	α -Caryophyllene	33,97	0,31
3-Carene	15,57	8,98	Borneol	34,56	1,87
β-Myrcene	16,10	0,56	Unknown with Mr 204	35,15	0,14
Limonene	17,55	2,73	γ-Cadinene	35,43	0,81
β-Phellandrene	17,94	2,54	Geranyl acetate	36,04	0,32
γ-Terpinene	19,35	0,17	L-Cadinene	36,38	0,24
p-Cymene	20,33	0,09	1,4-Cadinadiene	37,18	0,05
Terpinolene	20,56	0,05	Calamenene	38,59	0,07
Terpinolene	20,78	1,35	Unknown with Mr 207	39,89	0,10
4-Isopropenyltoluene	26,31	0,09	Unknown with Mr 220	41,26	0,17
α-Cubebene	26,97	0,26	1-Dodecanol	41,59	0,21
α-Longipinene	27,49	0,03	Caryophyllene oxide	42,82	0,09
Copaene	27,93	0,03	Nerolidol	43,51	0,06
α-Cubebene	28,24	0,24	α-Bisabolol	48,04	0,85
Camphora	29,18	0,74	Scarlene	51,13	0,10
Unknown with Mr 204	29,53	0,08	Epimanoyl oxide	51,61	0,65
β-Cubebene	29,72	0,18	Epimanoyl oxide	52,00	0,39
6-Camphenol	30,12	0,16	Dehydroabietine	54,25	0,13
Unknown with Mr 204	30,18	0,16	Manool	57,99	3,25

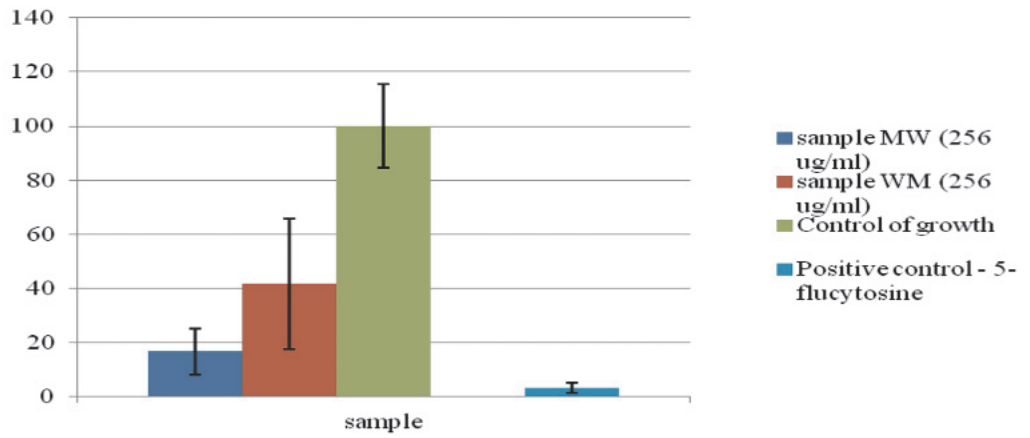
Notes:

Injector: T_{ij}. 250°C, Pressure 66,224 kPa, Septum purge flow 3 ml/min, Total flow 16,385, split 1:10.

Oven: Toven 40°C, 4 min, 4°C/min, 260°C, 4 min hold time, 63 final time, He, vacuum compensation ON, solvent delay time 4 min, equilibration time 0,25 min, max. oven temp. 300°C.

Detector: MS, Scan 29–650 m/z, Scans/second 1,22, Ttrans.line to MS 280°C, MS source 230°C, MS Quad 150°C.

Colu Column: Thermo Scientific P/N 260X296P, S/N 12967C07, TR-WAXMS, Length 30 m 0,25 mm I.D., 1,0 um film ticknes, 40°C, 66,224 kPa, 1,2168 ml/min, 40 cm/s, constant flow.



Antifungal activity of essential oils of Abies sibirica L.

Conclusions

1. Comparison of the data above with the available data on the chemical composition of the essential oil of Abies sibirica L., obtained by steam distillation, shows that the essential oil of Abies sibirica L., obtained by microwave heating, has a richer component composition. Bornyl acetate content of this oil is 34,26%.

2. Thus, our studies of the essential oils of Abies sibirica L. have revealed dependence of the oils properties on the ways the oils are obtained: the essential oil of Abies sibirica L, obtained by microwave heating, has a richer component composition and displays a higher antifungal activity towards Candida albicans than that one obtained by means of steam distillation.

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