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SHORT COMMUNICATION

Composition and antioxidant activity of the essential oil of *Artemisia annua* L

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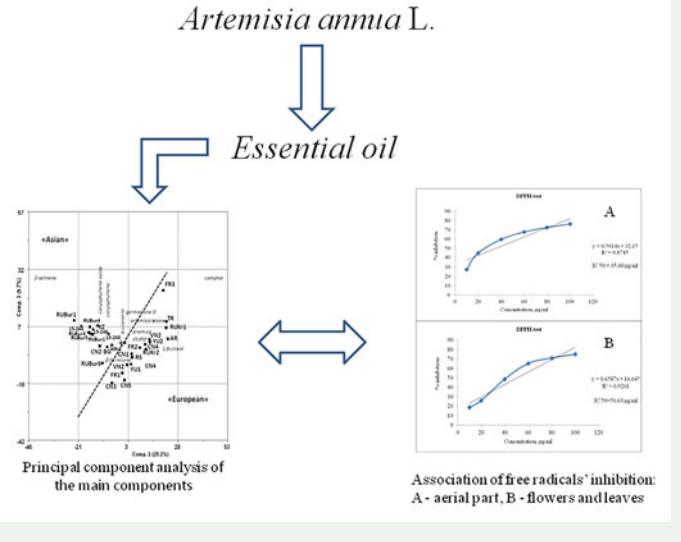
ABSTRACT

Artemisia annua L. is an annual Eurasian desert-steppe plant. The composition of essential oils found in *Artemisia annua* from Russian (Buryatian) flora was analyzed in this work using gas chromatography mass-spectrometry method. Artemisia ketone, β-selinene, caryophyllene, caryophyllene oxide, germacrene D were the main components of the analyzed essential oils. The comparison of own and literature data showed that the essential oils of *A. annua* conditionally could be divided into "Asian" and "European" groups. Our samples, referring to "Asian" profile, exhibited higher antiradical activity in comparison with data from previously published studies.



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1. Introduction

Artemisia annua L. (*Asteraceae*) is an annual Eurasian plant growing in desert and steppe country. It is widely spread in Europe, the Mediterranean, the Balkans, Armenia, Iran, China, Japan, Mongolia and North America (as adventitious plant). *Artemisia annua* L. has been cultivated in Brazil, Africa, India, Thailand, Afghanistan, Australia, Iran and Turkey (Konovalov and Khamilonov 2016). The current interest of this species occured after the isolation of Artemisinin – high-efficient antimalarial substance (Bhakuni et al. 2001).

The volume of Artemisinin and composition of essential oils from plants collected in different regions of Buryatia were shown in papers (Soktoeva et al. 2013; Zhigzhitzhapova et al. 2012). Biological activities of the essential oils of *A.annua* from different regions have been evaluated: antibacterial (Habibi et al. 2013, Guetat et al. 2017), antiradical – from cultivated (Cavar et al. 2012; Gouveia and Castilho 2013) and wild-growing plants (RaduloviC et al. 2013). But the possible antioxidant effect of *A.annua* from Buryatian flora hasn't been discussed. Therefore the main purpose of the paper was to study the chemical composition and antiradical activity of essential oils of *Artemisia annua* L. from Buryatian flora.

2. Results and discussion

The volume of the essential oil extracted from the whole aerial part of *A.annua* was 0.66% and from the mixture of flowers and leaves – 1.99%. Extracted oils were yellow, green-yellow (Table S1).

The composition of essential oils extracted from the whole aerial part and the mixture of flowers and leaves was similar (Table S2). The following constituents were found in all samples: (E)-β-farnesene (2.32–3.71%), germacra-4(15),5,10(14)-trien-1-ol (1.08–3.61%), artemisia alcohol 3-methyl butanoate (1.13–3.08%), yomogi alcohol (1,36–2,32%), artemisia alcohol 3-phenylpropionate (1.50–2.98%), artemisia alcohol 2-methyl butanoate (0,99–2,81%), α-copaene (1.58–2.83%), artemisia alcohol (0,47–1,86%), 1,8-cineol (0,39–1,72%).

According to the principal component analysis (Comp.1 – Comp.2) there were 2 groups: "Asian" and "European" (Figure S1). The first group was represented by samples from Asian countries with semi- and arid climates (except BG (Bulgaria, Tzenkova et al. 2010)): Kazakhstan (KZ, Suleymenov et al. 2002), Mongolia (MN, Shatar and Altantsetseg 2011), Qinghai province of China (CN2) and Buryatia (RUBur, Zhigzhitzhapova et al. 2012; Soktoeva et al. 2013). β-selinene, caryophyllene and caryophyllene oxide, artemisia ketone, germacrene D, α-copaene prevailed in essential oils of "Asian" group.

The samples from European countries with subhumid climate formed another group: Russia (Crimea, RUKr, Khodakov and Kotikov 2009), Turkey (TR, Soylu et al. 2005), France (FR2, Lawrence 1995; FR3, Juteau et al. 2002), Yugoslavia (YU, Lawrence 1995), Argentina (AR, Cafferata et al. 2010), Serbia (RS, RaduloviC et al. 2013), and from regions with tropical climate – Vietnam (VN, Lawrence 1996), Southern China (CN3-CN5, Lawrence 1992, 1996) and with subtropical climate – France (Marsel, FR1, Lawrence 1995). While in "European" group the dominant compounds were camphor,

1,8-cineole and artemisia alcohol. The majority of samples from countries with tropical and subtropical climate were characterized by accumulation of β-farnesene.

Antiradical activity of essential oils obtained from the aerial part and the mixture of flowers and leaves of *A. annua* showed the following results: EC_{50} of the essential oil from the aerial part – 50.63 mcg/ml and 35.60 mcg/ml – from the mixture of flowers and leaves. Two samples exhibited the high antiradical properties, whereas the activity of the essential oil from the mixture of flowers, leaves was 1.4 times higher than that from the whole aerial part (Figure S2).

Comparison with literature data showed that the results obtained from our samples exhibited higher antioxidant activity than shown in previous works from cultivated *A. annua's* plants from Bosnia (27,07 mg/ml, Cavar et al. 2012), Portugal (7.71–10.9 mol eq. Trolox/mL EO, Gouveia and Castilho 2013), and from wild-growing plants of Serbia (2.90 mg/ml, RaduloviC et al. 2013).

High antiradical activity of essential oils of *A. annua* from Buryatian flora can be attributed to the chemical composition. Analyzed samples, in comparison with reported in previous studies, referred to "Asian" chemotype. Two analyzed samples contained a high amount of β-selinene and artemisia ketone. To the best of our knowledge, artemisia ketone exhibited higher activity than camphor and 1,8-cineole in DPPH assay (RaduloviC et al. 2013). As mentioned in (Chandra et al., 2017), essential oils abundant in β-selinene exhibit high antiradical activity. Also, it is important to remember about synergistic and antagonistic interactions of constituents in complex multicomponent systems (that are essential oils).

3. Conclusion

The comparison of own and literature data showed that the essential oils of *A. annua* conditionally could be divided into "Asian" and "European" groups. The different antiradical activities among oils from different countries could be attributed to different chemical profiles - "Asian" and "European". Our samples, referring to "Asian" profile, exhibited higher antiradical activity in comparison with data from previously published studies (samples of "European" profile). Thus, in future essential oils of *Artemisia annua* from Buryatian flora can broaden the number of available and highly effective remedies used in different industries, including food, pharmacy, cosmetics and others.

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