SHORT COMMUNICATION

Chemical composition, antimicrobial and antioxidant activities of the essential oils of three Uzbek Lamiaceae species

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ABSTRACT

The chemical composition of the essential oil from the aerial parts of three Lamiaceae species from Uzbekistan was investigated by GC-MS analysis. \(\beta\)-Linalool (26.6%), \(\alpha\)-terpineol (10.0%), coumarin (8.9%) and 4,5,7,7\(\alpha\)-tetrahydro-4,4,7\(\alpha\)-trimethyl-2(6H)-benzofuranone (5.4%) resulted as the main components of \textit{Ajuga turkestanica} essential oil, while camphene (17.1%), 1,8-cineole (15.9%), \(\beta\)-cymene (7.9%) and limonene (7.4%) in \textit{Phlomis regelii}. The essential oil of \textit{Thymus seravschanicus} was dominated by thymol (37.5%), phellandral (26.0%), \(\tau\)-terpinene (6.6%) and \(\beta\)-cymene (5.2%). The essential oils had considerable antimicrobial activity against different bacterial strains and fungi. Among the tested samples of essential oils, \textit{P. regelii} essential oil has the significant antioxidant activity with \(IC_{50}\) value of 117.8 ± 8.02 \(\mu\)g/mL.

ARTICLE HISTORY

Received 31 October 2017
Accepted 15 February 2018

KEYWORDS

Lamiaceae; Uzbek Flora; essential oils; GC-MS; antimicrobial; antioxidant

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Supplemental data for this article can be accessed at https://doi.org/10.1080/14786419.2018.1443088.

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1. Introduction

The flora of Uzbekistan comprises 4344 species of which 238 belong to the Lamiaceae family (Sennikov et al. 2016). By the present work we would like to expand the knowledge on three Lamiaceae species such as Ajuga turkestanica Rgl. Brig., Phlomis regelii Popov and Thymus seravschanicus Klokov. Ajuga turkestanica (local name Kapalak qunmas) has been widely used in folk medicine for enhancement of muscular strength, against heart disease, muscle and stomach aches (Grace et al. 2008). Ecdysteroids, iridoids, neo-clerodane diterpenoids and some apolar compounds from the aerial parts and roots of A. turkestanica have been investigated previously (Mamadalieva et al. 2013; Guibout et al. 2015). Species of Phlomis L. have traditionally been used by Uzbek people as stimulant, tonic, diuretic and in the treatment of ulcers, hemorrhoids, wounds and gynecological problems (Sobeh et al. 2016). Phlomis regelii (local name Qo’zıquloq) is used in some places in Uzbekistan as honey plant and for feeding animals. Lipids, iridoid glycosides and alkaloids from aerial part of P. regelii have been investigated previously (Asilbekova et al. 1983; Maksudov et al. 1996; Razzakov et al. 2005). Thymus seravschanicus (local name Tog’jambil) is widely used in Uzbek folk medicine as an antimicrobial and antiseptic agent for treating throat diseases, bronchitis, tooth-ache, radiculitis, neuritis and spasms. From the aerial parts of T. seravschanicus we identified flavonoids, phenolics and organic acids (Mamadalieva et al. 2016).

Since there has been no study on the essential oil composition of A. turkestanica, P. regelii and T. seravschanicus growing in Uzbekistan. We investigated the chemical composition and we tested antimicrobial and antioxidant activities of essential oils obtained from the aerial parts of these species.

2. Results and discussion

2.1. Essential oil composition

The chemical composition of the essential oil from the aerial parts of the three Lamiaceae species was analyzed by GC-MS analysis (Table S1). The chemical composition of the essential oil from A. turkestanica, P. regelii and T. seravschanicus were investigated for the first time. 35 components were determined in the oil of A. turkestanica with β-linalool (26.6%), α-terpineol (10.0%), coumarin (8.9%), 4,5,7α-tetrahydro-4,4,7α-trimethyl-2(6H)-benzofuranone (5.4%) and eugenol (4.9%) representing the predominant components in the essential oil, in the essential oil of P. regelii 58 compounds were found and major ones were camphene (17.1%), 1,8-cineole (15.9%), β-cymene (7.9%), limonene (7.4%), trans-2-hexenal (4.6%) (representing 89.2 and 91.2% of the total, respectively). Meanwhile thymol (37.5%), phellandral (26.0%), τ-terpinene (6.6%), β-cymene (5.2%), and thymol acetate (3.1%) constitute the main components of the 63 compounds defined in T. seravschanicus essential oil (accounting for 95.8% of the peak area). As reported in Table S1, oxygenated monoterpenes represent the majority of components existing in the essential oil of A. turkestanica and T. seravschanicus.

2.2. Antibacterial and antifungal activity

The antibacterial and antifungal activity of the essential oils extracted from A. turkestanica, P. regelii, and T. seravschanicus against selected bacteria and fungus [Staphylococcus aureus (ATCC 25923), Bacillus subtilis (RKMUz 5), Pseudomonas aeruginosa (ATCC 27879), Escherichia...
coli (RKMUz 221) and Candida albicans (RKMUz 247)] was assessed using disc diffusion and micro-dilution methods (Table S2 and S3). According to these tables, T. seravschanicus and A. turkestanica essential oils had considerable antimicrobial activity against different bacterial strains and fungi (zone of inhibition in the range of 4–14 mm with MIC values between 115 and 500 μg/mL) (Figure S1). Thymol is characteristic constituent of the oil of many Thymus species, which are considered to be responsible for their biological activities (Rota et al. 2008). The antimicrobial properties of thymol are reported in previous studies (Marchese et al. 2016). Most reported species of Thymus were dominated by thymol. Our results highlight that the antimicrobial activity of essential oil of T. seravschanicus was greater than other samples. We assume that thymol might be responsible for the antimicrobial effect since it’s the main compound of the oil of T. seravschanicus (37.5%), whereas in P. regelii and A. turkestanica occur in trace amount and/or not at all.

2.3. Antioxidant activity
Concentration of the essential oil scavenging 50% of DPPH radical is shown in Table S4. Results indicated that the tested samples of essential oils were found to have a weak antioxidant activity. Greater IC$_{50}$ value (117.8 ± 8.02 μg/mL) was observed with essential oil of P. regelii.

3. Conclusions
In this research, for the first time, we evaluated the chemical profiles, antimicrobial and antioxidant activities of the essential oils obtained from A. turkestanica, P. regelii and T. seravschanicus. T. seravschanicus plant has pleasant aroma and flavor and rich source of essential oil, with a yield up to 5.8%. This plant can be used in perfumes and also can be commercial source of thymol and phellandral.

Supplemental material
Experimental details relating to this paper are available online, alongside Tables S1–3 and Figure S1.

Acknowledgement
The authors would like to thank BO Nigmatullaev for collecting the plant materials.

Disclosure statement
No potential conflict of interest was reported by the authors.

Funding
The part of this work was funded through a grant from the Republic of Uzbekistan State Foundation for Basic Research [grant number FA-F7-009].
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