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Short communication

Comparative characteristics of the chemical composition of *Veronica incana* L. (Plantaginaceae) in Yakutia

Vladimir V. Chemposov*, Nadezhda K. Chirikova

M.K. Ammosov North-Eastern Federal University, ul. Kulakovskogo 46, Yakutsk, Republic of Sakha (Yakutia), 660049 Russia

**soulkage94@gmail.com*

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Abstract. This publication provides a comparative description of the chemical composition of silver speedwell (*Veronica incana* L.). We chose three different regions of Yakutia as objects of study, namely: Megino-Kangalas District (Central Yakutia); Vilyuisk District (Western Yakutia); Oymyakon District (Eastern Yakutia). The content of certain groups of substances (phenolic compounds, tannins, flavonoids, and phenylpropanoids) in vegetable raw materials was studied. The highest content of all studied compounds was found in the leaves of *V. incana* L. growing in the Oymyakon District.

Keywords: silver speedwell, vegetable raw materials, phenolic compounds, tannins, flavonoids, phenylpropanoids

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Introduction

Silver speedwell *Veronica incana* L. is a flowering perennial plant with dark blue flowers assembled in a single spiky raceme (Opredelitel'..., 2020). Silver speedwell is found everywhere in Europe, China, Mongolia, and Russia. It is widespread in all regions of Yakutia, except for the Arctic regions. This species mostly grows in pine forests, in steppes, or on sandy and rocky-gravel slopes. According to published data, the best growing environments for the Yakut population of *V. incana* are recorded on the second floodplain terrace of the Lena River, in speedwell-wormwood-fescue steppe (Danilova and Semenova, 2015).

In Tibetan traditional medicine, plants of the genus *Veronica* are used for treatment of gastrointestinal disorders and cancer (Kosachev et.al, 2013). In traditional Yakut medicine, the herb *V. incana* was taken for diseases of the heart, lungs, stomach, and intestines. Among Yakut healers, preparations based on *V. incana* were considered to have broad range use for painkillers, wound healing, anti-inflammatories, etc. (Makarov, 1974).

According to publications, *V. incana* contains non-acylated and acylated flavone derivatives of luteolin, 6-hydroxyluteolin, apigenin, scutellarein, iridoids, nitrogen-containing compounds, cardiac glycosides, coumarins, lactones, and traces of saponins (Olennikov and Chirikova, 2021). It has been shown that leaves of *V. incana* growing in the South Urals contained: iridoids, 9.87%; tannins, 3.16%; and flavonoids, 2.43% (Nemereshina et al, 2015). Another similar study showed that the content of flavonoids in the leaves of *V. incana* from the Cisuralian steppe varied from 2.03 to 3.47%, depending on the place of growth

(Gusev and Nemereshina, 2005). The purpose of this study was to study the content of secondary metabolites (phenolic compounds, flavonoids, tannins and phenylpropanoids) in *V. incana* plant material from different regions of Yakutia and to analyze the influence of abiotic factors on secondary metabolites.

Materials and methods

Plant samples were collected in July 2021 in three districts of Yakutia: Megino-Kangalas (Central Yakutia, vicinity of Nizhniy Bestyakh, N 61°57′43″ E 129°54′44″), Vilyuisk (Western Yakutia, vicinity of Vilyuisk, N 63°44′48″ E 121°38′00″) and Oymyakon (Eastern Yakutia, vicinity of the village of Tomtor, N 63°15′45″ E 143°12′41″).

The collected samples were dried and brought to a standard state using the methods specified in the State Pharmacopoeia XIII (Gosudarstvennaya farmakopeya, 2015). Quantitative determination of the total content of the phenolic compounds was carried out using the Folin & Ciocalteu's phenol reagent (Singleton et al, 1999). Chlorogenic acid was used to determine the quantitative content of phenylpropanoids (Olennikov and Tankhaeva, 2011). The tannin content was determined using potassium permanganate (Gosudarstvennaya farmakopeya, 2015). The level of flavonoids was measured using a dominant flavonoid molar extinction coefficient (Gosudarstvennaya farmakopeya, 2015).

The research results were statistically studied using standard methods[1] including Microsoft Excel software and the Statistica 7.0 statistical software package.

Results and discussion

On the territory of all the studied regions, the climate is strongly continental, but with different mean annual temperatures. In Central Yakutia, the mean annual temperature is 11 °C; winter temperature reaches −45 °C, summer +38 °C; the average July temperature is +18.7 °C. The average annual precipitation in this region is 250–300 mm (Gavrilova, 1973). In Western Yakutia, the mean annual temperature is +7.6 °C; air temperature in winter reaches −62 °C, in summer it reaches up to +36 °C; the average July temperature is +16.8°C, the average annual precipitation is 250–300 mm (Zhirkova et al., 2012). In Eastern Yakutia, the average annual air temperature is –16.6 °C, in winter the air temperature drops to –70 °C, in summer it rises to 39 °C; the mean July temperature is +14.5 °C. Precipitation in this area is 170–300 mm (Ivanova, 2006; Savvinov et al., 2010).

The results of the analysis of the quantitative content of phenolic compounds of *V. incana* from different regions of Yakutia are presented in Table 1. The highest level of all studied groups of compounds is recorded in *V. incana* from the Oymyakon District followed by the sample of raw materials from the Vilyuisk District. The differences found are presumably related to thermal features of the habitats. Since phenolic compounds are responsible for plant protection from temperature fluctuations and preparation for the winter dormancy period (Kavelenova et al., 2001), their content increases with a decrease in the minimum winter and mean annual temperatures.

Temperature and ultraviolet (UV) radiation have been suggested to have the greatest effect on flavonoid accumulation (Chaves et al, 1997; Jansen et al, 1998). Due to the ability of flavonoids to absorb UV radiation in the range of 330–350 nm, they protect cells from excess light. This may explain the fact that we found the highest content of flavonoids in *V. incana* growing in the Oymyakon District: the longest daylight hours are observed here compared to other regions (Ivanova, 2006).

Tannins protect the plant organism from the impact of abiotic factors, form a barrier to infections or mechanical damage, and inactivate the hyperproduction of reactive oxygen species (Chupakhina, 2009; Khramova, 2016; Makarenko and Levitsky, 2013). Phenylpropanoids do not accumulate in plant cells in a free form but are involved in the biosynthesis of lignin and other compounds (Zagoskina et al., 2018). Lignins, along with tannins, protect plants from various abiotic factors (Khramova, 2016). Probably, *V. incana* from Eastern Yakutia has the greatest content of tannins and phenylpropanoids because of the severe climatic conditions of Oymyakon.

Conclusions

V. incana growing in the Oymyakon District (Eastern Yakutia) accumulates the greatest content of phenolic compounds, tannins, flavonoids and phenylpropanoids. These figures exceed the contents of the same substances in plants of similar populations from the Megino-Kangalas and Vilyuisk districts. This phenomenon is probably linked to the unique climatic and geographical characteristics of the Oymyakon region.

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ORCID

V.V. Chemposov 0000-0003-1850-3151
N.K. Chirikova 0000-0003-1130-3253

[1] OFS.1.1.0013.15 "Statistical processing of experimental results".

Table 1. Quantitative content of phenolic compounds in the aerial part of *V. incana.*

Group of compounds	Region		
	Central Yakutia	Western Yakutia	Eastern Yakutia
Phenolic compounds	23.499 ± 0.087%	37.618 ± 0.087%	40.552 ± 0.095%
Flavonoids	0.946 ± 0.038%	1.078 ± 0.043%	1.973 ± 0.069%
Tannins	4.364 ± 0.603%	5.533 ± 0.625%	8.314 ± 0.876%
Phenylpropanoids	1.438 ± 0.056%	1.763 ± 0.088%	2.323 ± 0.091%

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