



Characteristic of the chemical composition of *Artemisia pontica* L.

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A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation; D – writing the article; E – critical revision of the article; F – final approval of the article

The aim of this work is to determine the qualitative and quantitative characteristics of biologically active compounds of *Artemisia pontica* L. Definition prospects of medicinal herbal raw materials in the treatment of diseases.

Materials and methods. Research material (*Artemisia pontica* L. herb) was collected in August 2019 in the Zaporizhzhia region, Ukraine. The tincture was obtained by maceration. So, the tincture was being extracted with methyl alcohol at room temperature for 10 days. The tincture was extracted with methyl alcohol at room temperature for 10 days according to the method of preparing tinctures. The study of the chemical composition of tincture of *Artemisia pontica* L. was carried out using gas chromatograph Agilent 7890B GC System (Agilent, Santa Clara, CA, USA) with mass spectrometric detector Agilent 5977 BGC/MSD (Agilent, Santa Clara, CA, USA) and chromatographic column DB-5ms (30 m × 250 μm × 0.25 μm).

Results. 26 compounds were identified by analysis. Compounds such as n-hexadecanoic acid (16.71 %), 9,12,15-(Z,Z,Z)-octadecatrienoic acid (13.29 %), 2-(4a,8-dimethyl-7-oxo-1,2,3,4,4a,7-hexahydronaphthalen-2-yl)-propionic acid (8.80 %), 8-nitro-(1H)quinolin-4-ol-2-one (6.45 %) and neophytadiene (4.66 %) prevail in tincture. A literature review showed that n-hexadecanoic acid stimulates anti-inflammatory processes in human immune cells through TLR4 receptors, it has antitumor and antidiabetic activity and it also has anti-inflammatory effects. Derivatives of 9,12,15-(Z,Z,Z)-octadecatrienoic acid are used in diabetes therapy. 2-(4a,8-Dimethyl-7-oxo-1,2,3,4,4a,7-hexahydronaphthalen-2-yl)-propionic acid is an immunosuppressant and probably improves tissue insulin sensitivity. In addition, it is necessary to underline the presence of neophytadiene that has an anti-inflammatory effect. The presence of β-phellandrene provides insecticidal and eucalyptol anti-inflammatory effects.

Conclusions. Considering the individual actions of the individual components, *Artemisia pontica* L. herb can be recommended for further research on its anti-inflammatory, antidiabetic, and antitumor effects.

Key words: *Artemisia pontica*, chromato-mass spectroscopy, component composition, quantitative content.

Current issues in pharmacy and medicine: science and practice 2021; 14 (1), 23–28

Характеристика хімічного складу *Artemisia pontica* L.

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Мета роботи – встановлення якісних і кількісних характеристик біологічно активних сполук *Artemisia pontica* L.; визначення перспектив використання лікарської рослинної сировини для лікування захворювань.

Матеріали та методи. Матеріал для дослідження (*Artemisia pontica* L. трава) зібраний у серпні 2019 р. у Запорізькій області. Настойку одержували методом мацерації. Сировину екстрагували метиловим спиртом за кімнатної температури протягом 10 днів за способом приготування настоек. Хімічний склад настоек *Artemisia pontica* L. вивчали за допомогою газового хроматографа Agilent 7890B GC System (Agilent, Санта-Клара, Каліфорнія, США) з мас-спектрометричним детектором Agilent 5977 BGC/MSD (Agilent, Santa Clara, CA, США) та хроматографічної колонки DB-5ms (30 м × 250 мкм × 0,25 мкм).

Результати. Під час аналізу встановили 26 сполук. У настійці переважали такі сполуки, як н-гексадеканова кислота (16,71 %), 9,12,15-(Z,Z,Z)-октадекатрієнова кислота (13,29 %), 2-(4а,8-диметил-7-оксо-1,2,3,4,4а,7-гексагідронафтален-2-іл)-пропіонова кислота (8,80 %), 8-нітро-(1Н) хінолін-4-ол-2-он (6,45 %) та неофітадієн (4,66 %). Огляд фахової літератури показав, що н-гексадеканова кислота стимулює протизапальні процеси в імунних клітинах людини через рецептори TLR4, має протипухлинну, протидіабетичну та протизапальну дію.

Похідні 9,12,15-(Z,Z,Z)-октадекатрієнової кислоти використовують у терапії діабету. 2-(4а,8-диметил-7-оксо-1,2,3,4,4а,7-гексагідронафтален-2-іл)-пропіонова кислота є імунодепресантом і, ймовірно, поліпшує чутливість тканин до інсуліну. Необхідно підкреслити наявність неофітадієну, який має протизапальну дію. Наявність β-фелландрену та евкалиптолу забезпечує інсектицидну та протизапальну дію відповідно.

ARTICLE INFO



<http://pharmed.zsmu.edu.ua/article/view/226743>

UDC 615.322:582.998.16-119.2

DOI: [10.14739/2409-2932.2021.1.226743](https://doi.org/10.14739/2409-2932.2021.1.226743)

Current issues in pharmacy and medicine: science and practice 2021; 14 (1), 23–28

Key words: *Artemisia pontica*, chromato-mass spectroscopy, component composition, quantitative content.

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Received: 05.11.2020 // Revised: 17.11.2020 // Accepted: 23.11.2020

Висновки. Враховуючи індивідуальні дії окремих компонентів, *Artemisia pontica* L. траву можна рекомендувати для наступних досліджень щодо її протизапальної, протидіабетичної та протипухлинної дії.

Ключові слова: *Artemisia pontica*, хромато-мас-спектроскопія, компонентний склад, кількісний вміст.

Актуальні питання фармацевтичної і медичної науки та практики. 2021. Т. 14, № 1(35). С. 23–28

Характеристика химического состава *Artemisia pontica* L.

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Цель работы – определение качественных и количественных характеристик биологически активных соединений *Artemisia pontica* L.; определение перспектив использования лекарственного растительного сырья для лечения заболеваний.

Материалы и методы. Материал для исследования (травя *Artemisia pontica* L.) собран в августе 2019 г. в Запорожской области, Украина. Настойку получали путем мацерации. Сырье экстрагировали метиловым спиртом при комнатной температуре в течение 10 дней согласно методу приготовления настоек. Химический состав настойки *Artemisia pontica* L. изучали с помощью газового хроматографа Agilent 7890B GC System (Agilent, Санта-Клара, Калифорния, США) с масс-спектрометрическим детектором Agilent 5977 BGC/MSD (Agilent, Santa Clara, CA, США) и хроматографической колонки DB-5ms (30 м × 250 мкм × 0,25 мкм).

Результаты. В ходе анализа установлены 26 соединений. В настойке преобладали такие соединения, как н-гексадекановая кислота (16,71 %), 9,12,15-(Z,Z,Z)-октадекатриеновая кислота (13,29 %), 2(4а,8-диметил-7-оксо-1,2,3,4,4а,7-гексагидронафтален-2-ил)-пропионовая кислота (8,80 %), 8-нитро(1H)-хинолин-4-ол-2-он (6,45 %) и неофитадиен (4,66 %). Обзор научной литературы показал, что н-гексадекановая кислота стимулирует противовоспалительные процессы в иммунных клетках человека через рецепторы TLR4, обладает противоопухолевым, противодиабетическим и противовоспалительным действиями. Производные 9,12,15-(Z, Z, Z)-октадекатриеновой кислоты используют в терапии диабета. 2(4а,8-диметил-7-оксо-1,2,3,4,4а,7-гексагидронафтален-2-ил)-пропионовая кислота – иммунодепрессант, вероятно, улучшает чувствительность тканей к инсулину. Следует отметить наличие неофитадиена, который обладает противовоспалительным действием. Наличие β-фелландрена и эвкалиптола обеспечивает инсектицидное и противовоспалительное действие соответственно.

Выводы. Учитывая индивидуальные действия каждого компонента, *Artemisia pontica* L. траву можно рекомендовать для дальнейших исследований на противовоспалительное, противодиабетическое и противоопухолевое действия.

Ключевые слова: *Artemisia pontica*, хромато-масс-спектроскопія, компонентний склад, кількісний вміст.

Актуальные вопросы фармацевтической и медицинской науки и практики. 2021. Т. 14, № 1(35). С. 23–28

The genus *Artemisia* L. includes more than 400 species that belong to the Asteraceae family. *Artemisia pontica* L. is a shrub with a height of 40–100 cm with a creeping rhizome and a lignified stem in the lower part, densely leafy from the middle and above [1].

This is an ornamental plant. It is distributed mainly in the southern part of Central and Eastern Europe. In Ukraine, *Artemisia pontica* L. is found in Mykolaiv, Odesa, and Zaporizhzhia regions. It grows in dry meadows, clearings, forest edges, and the steppes [2].

It is used in medicine as an antiseptic for the oral cavity (Maraslavin, Bulgaria). Research data revealed the presence of anti-inflammatory, analgesic, wound healing, antifungal, and antimicrobial effects [3,4].

Artemisia pontica L. was previously cultivated as a spicy-aromatic plant in Western Europe and North America. Although *Artemisia pontica* L. is grown as an ornamental plant in gardens, it can also be used as feed for small livestock, horses, and camels [5].

There are evident facts that plants of the genus *Artemisia* L. have anthelmintic, antibacterial, antifungal, repellent, narcotic [6–8], antioxidant [9–11] properties. However, they also have toxic effects [6,12].

Despite the potential perspective of using this plant in medicine, the chemical composition of *Artemisia pontica* L. populations that grow in Ukraine is not well investigated. Before the research of the chemical composition of the herb *Artemisia pontica* L. was conducted.

Aim

To determine the qualitative and quantitative characteristics of biologically active compounds of *Artemisia pontica* L. Definition prospects of medicinal herbal raw materials in the treatment of diseases.

Materials and methods

Plant materials. Research material (*Artemisia pontica* L. herb) was collected in August 2019 in the Zaporizhzhia region. Herbarium samples were deposited at the herbarium of the Faculty of Pharmacy of Zaporizhzhia State Medical University.

Extraction. According to the general method of preparing tinctures, the tincture was obtained by maceration. The tincture was being extracted with methyl alcohol at room temperature for 10 days [13]. Then 0.1 ml of tincture was placed in a 1 ml micro flask and was brought with methanol to 0.5 ml.

Equipment. The completeness of the reactions and the individuality of the resulting compounds were controlled by the gas chromatograph Agilent 7890B with a 5977B mass spectrometry detector. The column was DB-5ms 30 m × 250 μm × 0.25 μm with length. The gas-carrier speed (helium) was 1.6 ml/min. Injection volume was 0.5 μl. The separation of the flow was 1:50. The temperature of the sampling unit was 230 °C → 12 °C/s → 275 °C. Thermostat temperature: programmable, 240 °C (1-minute

delay) → 5 °C/min → 280 °C (1-minute delay). The total time of examination were 10 min. Temperature of interface GS/MS – 280 °C; ion sources – 230 °C; quadrupole mass analyzer – 150 °C. Type of ionization: EI with an electron energy of 70 eV. The range of mass numbers that was scanned: 30–500 m/z.

Results

It was found that the methanol tincture of *Artemisia pontica* L. contains 26 different components. Among them, it was identified: 5 fatty acids (41.24 %), terpenoids of different classes – 16 (29.83 %), heterocyclic compounds – 2 (7.67 %), alkenes – 1 (6.33 %), triterpenes of carboxylic acids – 1 (1.23 %), cycloalkane alcohol – 1 (0.89 %).

Compounds such as N-hexadecanoic acid (16.71 %), 9,12,15-(Z,Z,Z)-octadecatrienoic acid (13.29 %), 2-(4a,8-dimethyl-7-oxo-1,2,3,4,4a,7-hexahydronaphthalen-2-yl)-pro-

pionic acid (8.80 %), 8-nitro-(1H)quinolin-4-ol-2-one (6.45 %) and neophytadiene (4.66 %) are quantitatively prevail among the total content of all components.

The results of the study are in *Table 1*.

Such components as n-hexadecanoic acid with a retention time of 16.27 min and 9,12,15-(Z,Z,Z)-octadecatrienoic acid (RT = 17.917 min) were identified on chromatogram of the components of *Artemisia pontica* L. (*Fig. 1*).

Discussion

The populations of *Artemisia pontica* L. that grow on the territory of Ukraine differ significantly from the populations of other countries in chemical composition. The main active ingredients of the Kazakhstan fraction are flavonoids 7-O-methyl- and 4',7-di-O-methyl-esters of apigenin [14], while the Ukrainian fraction is dominated by fatty acids. Regarding the study of the component composition of water extracts of other *Arte-*

Table 1. Qualitative and quantitative composition of biologically active substances of *Artemisia pontica* L.

	RT, min	Compound Label	Area Sum %
1.	4.125	β-phellandrene	3.69
2.	4.914	Eucalyptol	3.37
3.	5.412	2-methyl-5-(1-methylethyl)-, (1α, 2β, 5α)-bicyclo[3.1.0]hexan-2-ol	0.95
4.	5.761	(1R,4R,5S)-1-isopropyl-4-methoxy-4-methylbicyclo[3.1.0]hexane	1.37
5.	6.879	endo-borneol	1.25
6.	7.176	L-α-terpineol	1.1
7.	10.129	1-deoxy-inositol	0.89
8.	12.326	Caryophyllene oxide	1.22
9.	12.596	Quinic acid	1.23
10.	13.205	Neointermedeol	1.82
11.	14.011	Chamazulene	1.26
12.	14.164	Tetradecanoic acid	0.92
13.	14.903	1-heptatriacotanol	1.71
14.	15.006	Neophytadiene	4.66
15.	15.257	Phytol, acetate*	1.21
16.	15.449	Phytol, acetate*	1.91
17.	15.757	8-nitro-(1H)quinolin-4-ol-2-one	6.45
18.	16.27	n-hexadecanoic acid	16.71
19.	17.215	4-(3-mercapto-4-methyl-5-(4H-1,2,4-triazolyl))-pyridine	1.22
20.	17.364	2-(4a,8-dimethyl-7-oxo-1,2,3,4,4a,7-hexahydronaphthalen-2-yl)-propionic acid	8.8
21.	17.689	Phytol	4.4
22.	17.917	9,12-(Z,Z)-octadecadienoic acid	1.52
23.	17.978	9,12,15-(Z,Z,Z)-octadecatrienoic acid	13.29
24.	18.212	2,6,10,15,19,23-(all-E)-hexamethyl-1,6,10,14,18,22-tetracosahexaen-3-ol	2.07
25.	18.787	1-heptatriacotanol	2.5
26.	22.837	17-pentatriacontene	1.67

*: these compounds are believed to be isomers.

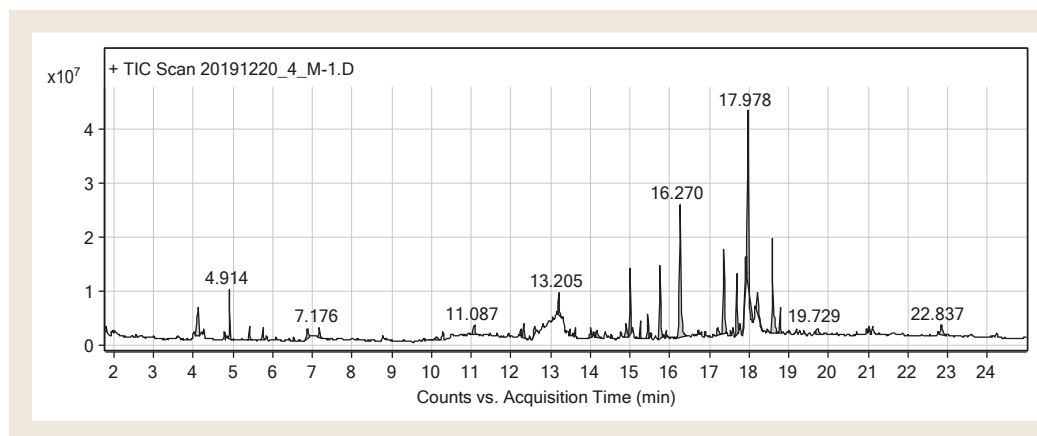


Fig. 1. Chromatogram of *Artemisia pontica* L. components.

misia L. species, Russian scientists found that laminitol was the dominant component of aqueous extracts of *A. absinthium* L., *A. latifolia* Ledeb., *A. armeniaca* Lam. [15].

Considering the terpenoid fraction, the majority of the Ukrainian population are β -phellandrene and eucalyptol. Cimol and 1,8-cineole prevail in Siberian populations [16]; α -thujone [17] dominates in Moroccan population; 1,8-cineole and camphor prevail in Bulgarian population [18].

It should be noted that the terpenoid fraction of *Artemisia pontica* L. was significantly different in chemical composition from the other representatives of the genus *Artemisia* L. For example, *A. absinthium* L. had the highest β -myrcene content, *A. austriaca* Jacq. had camphor [9], and *A. frigida* Willd. had 1,8-cineole and camphor, *A. argrophylla* contained artemisia ketone and artemisia alcohol acetate [19].

The literature review illustrated that n-hexadecanoic acid (palmitic acid) was the most common fatty acid in nature, which was a part of the glycerides of most animal fats, vegetable oils, and waxes. It had stimulated anti-inflammatory processes in human immune cells through TLR4 receptors [20], it had antitumor and antidiabetic activity [21] and it also had anti-inflammatory effects [22].

9,12,15-(Z,Z,Z)-octadecatrienoic acid was an isomer of 5,9,12-(Z,Z,Z)-octadecatrienoic acid that was better known as pinolenic acid. It had been established that pinolenic acid can affect immune processes [23], and was a dual FFA1/FFA4 agonist with potential effect against metabolic diseases such as insulin resistance and type 2 diabetes [24].

There was also experimental data on the presence of cholesterol-lowering effect on the LDL receptor activity of human hepatoma HepG2 cells [25]. Investigations of pinolenic acid as an inhibitor of human breast cancer MDA-MB-231 cell metastasis in vitro may be perspective [26].

2-(4a,8-dimethyl-7-oxo-1,2,3,4,4a,7-hexahydronaphthalen-2-yl)-propionic acid was a propionic acid derivative that was known to be lowers fatty acids content in liver and plasma, reduces food intake, exerts immunosuppressive actions and probably improves tissue insulin sensitivity [27].

In addition, it was necessary to underline the presence of neophytadiene that has an anti-inflammatory effect [28].

The presence of β -phellandrene provides insecticidal [29] and eucalyptol anti-inflammatory effect [30,31].

Considering the given all the above the herb *Artemisia pontica* L. can be recommended for further studies due to its anti-inflammatory, antidiabetic and antitumor effects.

Conclusions

1. For the first time the qualitative and quantitative composition of the components of the *Artemisia pontica* L. herb that grows in Ukraine was established by using a gas chromatogram;

2. It was identified 26 components that belong to different classes of biologically active compounds;

3. The quantitative content was dominated by n-hexadecanoic acid (16.71 %), 9,12,15-(Z,Z,Z)-octadecatrienoic acid (13.29 %), 2-(4a,8-dimethyl-7-oxo-1,2,3,4,4a,7-hexahydronaphthalen-2-yl)-propionic acid (8.80 %), 8-nitro-(1H)quinolin-4-ol-2-one (6.45 %), and neophytadiene (4.66 %). Considering their biological effect, the studied raw materials can be recommended for further studies on anti-inflammatory, antidiabetic, and antitumor effects.

Prospects for further research. The herb of *Artemisia pontica* L. is a source of biologically active substances that have anti-inflammatory, antidiabetic and antitumor effects.

Funding

The research is an integral part of the joint complex work of Department of Pharmacognosy, Pharmacology and Botany of Zaporizhzhia State Medical University.

Conflicts of interest: authors have no conflict of interest to declare.

Конфлікт інтересів: відсутній.

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