Research of the chemical composition of *Artemisia tschernieviana Bess.* by gas chromatography method with mass detection

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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;
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The aim of the work was to study chromato-mass spectroscopic of *Artemisia tschernieviana Bess.* grass and to establish possible prospects for the use of this plant in medical practice.

Materials and methods. *Artemisia tschernieviana Bess.* grass was chosen as the object of research. Raw materials were collected in July 2021 in the flowering phase (Zaporizhzhia). The tincture was obtained by maceration and the raw material was extracted with methyl alcohol at room temperature for 10 days according to the method of making tinctures. The study of the chemical composition of *Artemisia tschernieviana Bess.* Grass 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. During the study it was found that the composition of *Artemisia tschernieviana Bess.* grass includes 21 compounds (2 in the isomeric state). β-myrcene (17.22 %), sabinene (14.54 %), 2-(4a,8-dimethyl-7-oxo-1,2,3,4,4a,7-hexahydronaphthalen-2-yl) propionic acid (11.57 %), 2-dodecen-1-yl-succinic anhydride (10.84 %) and chamazulene (9.02 %) accounted for the largest percentage.

According to the literature review, myrcene has antibacterial, anesthetic and analgesic effects. Sabinene is characterized by antibacterial action. 2-(4a,8-dimethyl-7-oxo-1,2,3,4,4a,7-hexahydronaphthalen-2-yl)-propionic acid is a fatty acid with possible antibacterial and anti-inflammatory activity. 2-dodecen-1-yl-succinic anhydride is used to produce anhydride-modified form of insulin that can be used in the treatment of diabetes. Hamazulen has anti-inflammatory activity.

Conclusions. In view of all the above, we can conclude that *Artemisia tschernieviana Bess.* grass can be recommended for further research as a source of potential anti-inflammatory and antibacterial agents.

Key words: *Artemisia tschernieviana*, GS-MS, component composition, quantitative content, anti-inflammatory effect, antidiabetic effect, antibacterial effect.

Current issues in pharmacy and medicine: science and practice 2021; 14 (3), 282–286

Дослідження хімічного складу *Artemisia tschernieviana Bess.* методом газової хроматографії з мас-детекцією

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Мета роботи – визначення хімічного складу полину Черняєва трави, встановлення перспективності її дослідження як потенційного джерела лікарських засобів з антибактеріальною та протизапальною діями.

Матеріали та методи. Об'єкт дослідження – полину Черняєва трава. Сировину зібрали в липні 2021 року у фазу цвітіння (м. Запоріжжя). Настойку одержали методом мацерації, сировину екстрагували метиловим спиртом за кімнатної температури протягом 10 днів відповідно до методики виготовлення настойок. Хімічний склад настойки 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. У результаті дослідження встановили, що полину Черняєва трава містить 21 сполуку (2 – в ізомерному стані). Найбільший відсоток становили β-мірцен (17,22 %), сабінен (14,54 %), 2-(4a,8-диметил-7-оксо-1,2,3,4,4a,7-гексагідронафтален-2-іл)-пропіонова кислота (11,57 %), 2-додецен-1-іл-сукциновий ангідрид (10,84 %), хамазулен (9,02 %). Відомо, що мірцену притаманна антибактеріальна, знеболювальна та аналгетична дії. Для сабінену характерна антибактеріальна дія. 2-(4a,8-диметил-7-оксо-1,2,3,4,4a,7-гексагідронафтален-2-іл)-пропіонова кислота – жирна кислота з можливою антибактеріальною та протизапальною активністю. 2-додецен-1-іл-сукциновий ангідрид використовують для отримання ангідрид-модифікованої форми інсуліну, який можна застосовувати в терапії цукрового діабету. Хамазулен характеризується протизапальною дією.

Висновки. Полину Черняєва траву можна рекомендувати для наступних досліджень як потенційне джерело протизапальних та антибактеріальних засобів.

Ключові слова: *Artemisia tschernieviana*, GS-MS, компонентний склад, кількісний вміст, протизапальний ефект, протидіабетичний ефект, антибактеріальний ефект.

Исследование химического состава *Artemisia tschernieviana Bess.* методом газовой хроматографии с масс-детекцией

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Цель работы – определение химического состава полыни Черняева травы, установление перспективности её исследования как потенциального источника лекарственных средств с антибактериальным и противовоспалительным действиями.

Материалы и методы. Объект исследования – полыни Черняева трава. Сырьё собрано в июле 2021 года в фазу цветения (г. Запорожье). Настойку получали методом мацерации, сырье экстрагировали метиловым спиртом при комнатной температуре в течение 10 дней в соответствии с методикой изготовления настоек. Химический состав настойки изучили 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 исследования установлено, что полыни Черняева трава содержит 21 соединение (2 – в изомерном состоянии). Наибольший процент составили β-мирцен (17,22 %), сабинен (14,54 %), 2-(4а,8-диметил-7-оксо-1,2,3,4,4а,7-гексагидронафта-лен-2-ил)-пропионовая кислота (11,57 %), 2-додецен-1-ил-сукциновый ангидрид (10,84 %) и хамазулен (9,02 %).

Известно, что мирцен характеризуется антибактериальным, анестезирующим и анальгезирующим действиями. Сабинен проявляет антибактериальное действие. 2-(4а,8-диметил-7-оксо-1,2,3,4,4а,7-гексагидронафтален-2-ил)-пропионовая кислота – жирная кислота с вероятным антибактериальным и противовоспалительным эффектами. 2-додецен-1-ил-сукциновый ангидрид используют для получения ангидрид-модифицированной формы инсулина, который можно применять в терапии сахарного диабета. Хамазулен обладает противовоспалительным действием.

Выводы. Полыни Черняева трава может быть рекомендована для дальнейших исследований как источник потенциальных противовоспалительных и антибактериальных средств.

Ключевые слова: *Artemisia tschernieviana*, GS-MS, компонентный состав, количественное содержание, противовоспалительный эффект, противодиабетический эффект, антибактериальный эффект.

The genus *Artemisia* is one of the largest and most common plants in the family *Asteraceae* [1,2]. It has more than 400 species that grow mainly throughout the northern hemisphere, in the temperate zone of Eurasia, in North and South Africa, North America [3]. There are 22 species on the territory of Ukraine. Representatives of the genus are mainly annual, biennial, and perennial herbaceous plants or shrubs, usually aromatic [4,5].

Many species of *Artemisia* are the subject of research by scientists from around the world. In particular, this is due to the complex chemical composition of these plants and the presence of a wide range of biological effects [6,7]. Thus, several scientists confirm the presence of cytotoxic and anti-tumor effects in some species of the genus [8]. For example, German scientists have confirmed the high effectiveness of *Artemisia annua L.* extract against breast cancer [9]. Pakistani researchers describe the presence of antitumor, cytotoxic, antimalarial, and antidiabetic effects in *Artemisia maritima L.* [10]. A wide range of biological action is characteristic of *Artemisia absinthium L.* Thus, there are data on its use as an antioxidant, antifungal, antimicrobial, anthelmintic, antiulcer, hepatoprotective, and analgesic [11]. A similar effect is characteristic of *Artemisia nilagirica L.* [12].

However, the further literature review revealed a lack of information on the chemical composition and use of *Artemisia tschernieviana Bess.* This confirms the feasibility and relevance of research in this area.

Aim

The aim of the work was to study chromato-mass spectroscopic of *Artemisia tschernieviana Bess.* grass and to establish possible prospects for the use of this plant in medical practice.

Materials and methods

Plant materials. The object of the study was *Artemisia tschernieviana Bess.* grass. Raw materials were collected in July 2021 in the flowering phase (Zaporizhzhia, Ukraine).

Extraction. The tincture was obtained by maceration, and the raw material was extracted with methyl alcohol at room temperature for 10 days according to the method of making tinctures. 0.1 ml of the extract was placed in a 1 ml micro flask and made up to 0.5 ml with methanol [13].

Equipment. Qualitative and quantitative determination of active compounds was carried out at the Department of Natural Sciences for Foreign Students and Toxicological Chemistry (Head of the Department – Dr. hab., Professor O. I. Panasenko).

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 is DB-5ms 30 m × 250 μm × 0.25 μm with length. The gas-carrier speed (helium) is 1.6 ml/min. Injection volume – 0.5 μl. Separation of the flow is 1:50.

Table 1. Qualitative and quantitative content of biologically active compounds of *Artemisia tschernieviana Bess.* grass

Compound Label	RT	Area Sum %	DB Formula
Cpd 1: 2,2-Dimethoxybutane	1.971	1.86	$C_6H_{14}O_2$
Cpd 2: Bicyclo[3.1.0]hexane, 4-methylene-1-(1-methylethyl)-	4.117	14.54	$C_{10}H_{16}$
Cpd 3: .beta.-Myrcene	4.267	17.22	$C_{10}H_{16}$
Cpd 4: Linalool	5.761	2.46	$C_{10}H_{18}O$
Cpd 5: Caryophyllene	10.285	1.71	$C_{15}H_{24}$
Cpd 6: Galacto-heptulose	10.426	1.16	$C_7H_{14}O_7$
Cpd 7: Benzene,[(tetramethylcyclopropylidene) methyl]-	12.815	6.62	$C_{14}H_{18}$
Cpd 8: 3,6-Dihydrochamazulene	13.115	5.78	$C_{14}H_{18}$
Cpd 9: (4R,4aR)-4,4a-Dimethyl-6-(prop-1-en-2-yl)-1,2,3,4,4a,7-hexahydronaphthalene	13.357	1.71	$C_{15}H_{22}$
Cpd 10: 1,4-Diacetyl-3-acetoxymethyl-2,5-methylene-l-rhamnitol	13.548	1.04	$C_{14}H_{22}O_8$
Cpd 11: Chamazulene	14.003	9.02	$C_{14}H_{16}$
Cpd 12: (E)-1-(6,10-Dimethylundeca-5,9-dien-2-yl)-4-methylbenzene	16.788	1.46	$C_{20}H_{30}$
Cpd 13: 2-(4a,8-Dimethyl-7-oxo-1,2,3,4,4a,7-hexahydronaphthalen-2-yl)-propionic acid	17.357	11.57	$C_{15}H_{20}O_3$
Cpd 14: Glabellin	17.428	1.64	$C_{15}H_{18}O_3$
Cpd 15: Phytol	17.677	3.86	$C_{20}H_{40}O$
*Cpd 16: 2-Dodecen-1-yl(-)succinic anhydride	18.358	2.04	$C_{16}H_{26}O_3$
Cpd 17: .alpha.-Santonin	18.596	0.92	$C_{15}H_{18}O_3$
Cpd 18: Longifolenaldehyde	18.658	1.91	$C_{15}H_{24}O$
*Cpd 19: 2-Dodecen-1-yl(-)succinic anhydride	18.785	8.80	$C_{16}H_{26}O_3$
Cpd 20: 14-Formol-9-hydroxyarteether	19.006	1.67	$C_{17}H_{26}O_7$
*Cpd 21: Anthracen-1(2H)-one, 3,4-dihydro-8,9,10-trihydroxy-	19.185	1.01	$C_{14}H_{12}O_4$
*Cpd 22: Anthracen-1(2H)-one, 3,4-dihydro-8,9,10-trihydroxy-	19.514	1.04	$C_{14}H_{12}O_4$
Cpd 23: 17-Pentatriacontene	22.816	0.97	$C_{35}H_{70}$

*: these compounds are probably isomers.

The temperature of the sampling unit is 230 °C → 12 °C/s → 275 °C. Thermostat temperature: programmable, 240 °C (1 minute delay) → 5 °C/min → 280 °C (delay 1 min). The total time of examination is 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

According to the results of the study, 21 compounds were identified (2 in the isomeric state) (*Table 1*).

Regarding chemical analysis, the largest percentage was β-myrcene (17.22 %), sabinene (14.54 %), 2-(4a, 8-dimethyl-7-oxo-1,2,3,4,4a, 7-hexahydronaphthalene-2-yl)-propionic acid (11.57 %), 2-dodecen-1-yl-succinic anhydride (10.84 %) and chamazulene (9.02 %). Of the total content, terpenes were accounted for 59.06 %, aromatic compounds – 11.84 %, fatty acid derivatives – 11.57 %, organic acid derivatives – 10.84 %, hydrocarbons – 2.83 %, sugars – 2.2 %, ester – 1.67 %.

The chromatogram of *Artemisia tschernieviana Bess.* tincture identified the following compounds: β-myrcene (RT = 4.267), 2-(4a, 8-dimethyl-7-oxo-1,2,3,4,4a, 7-hexa-hydronaphthalen-2-yl)-propionic acid (RT = 17.357), 2-do-decen-1-yl-succinic anhydride (RT = 18.785) (*Fig. 1*).

Discussion

According to the literature review, myrcene has antibacterial, anesthetic, and analgesic effects. American scientists have studied the analgesic effect of a mixture of cannabinoids and myrcene and concluded on the prospects of their joint use [14].

Sabinene is characterized by antibacterial action [15].

2-(4a, 8-dimethyl-7-oxo-1,2,3,4,4a, 7-hexahydronaphtha-len-2-yl)-propionic acid is a derivative of propionic acid, which is the lowest fatty acid. According to the literature, propionic acid and its derivatives have antibacterial and anti-inflammatory activity [16].

2-dodecen-1-yl-succinic anhydride is used to produce the anhydride-modified form of insulin that can be used in the treatment of diabetes [17].
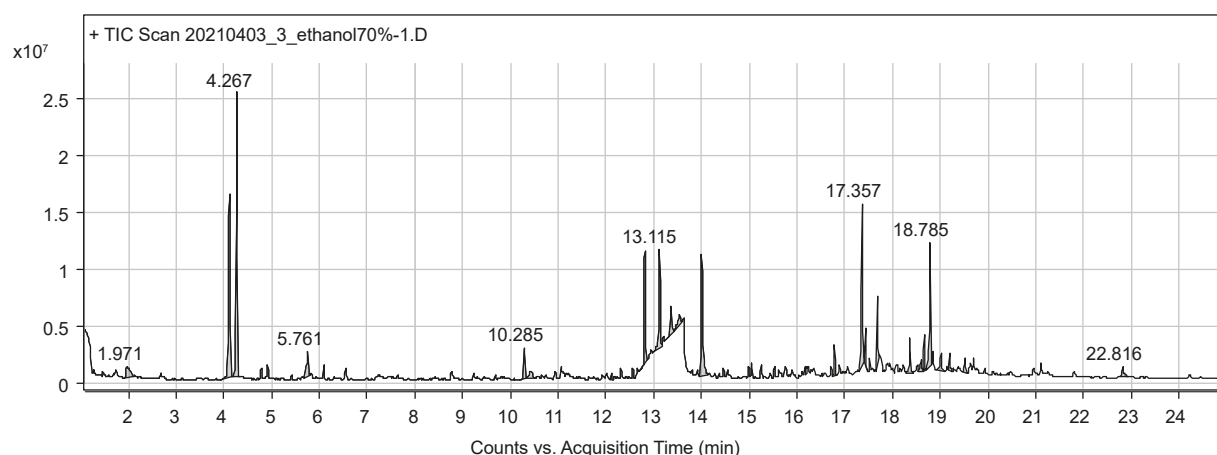
Fig. 1. Chromatogram of *Artemisia tschernieviana Bess.* grass.

Hamazulene is known as an anti-inflammatory agent [18] and may be included in the treatment of osteoarthritis [19].

In view of all the above, we can conclude that wormwood Chernyaeva grass can be recommended for further research as a source of potential anti-inflammatory and antibacterial agents.

Conclusions

1. For the first time with the help of GS/MS was established the chemical composition of *Artemisia tschernieviana Bess.* grass.

2. During the study of raw materials, 21 (2 in the isomeric state) biologically active compounds were identified.

3. The main components were β-myrcene (17.22 %), sabinene (14.54 %), 2-(4a, 8-dimethyl-7-oxo-1,2,3,4,4a, 7-hexahydronaphthalen-2-yl)-propionic acid (11.57 %), -dodecen-1-yl-succinic anhydride (10.84 %), and chamazulene (9.02 %).

4. The obtained results testify to the prospects of further research of *Artemisia tschernieviana Bess.* grass as a potential source of drugs with antibacterial and anti-inflammatory action.

Prospects for further research. *Artemisia tschernieviana Bess.* grass can be used as a source of potential drugs with antibacterial and anti-inflammatory effects.

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