Chromato-mass-spectroscopic research of chemical composition of Elaeagnus angustifolia L.

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The aim of the work was chromato-mass-spectroscopic research of chemical composition of Elaeagnus angustifolia L. fruits and leaves and identifying further prospects for the use of this plant in medicine.

Materials and methods. Raw materials of Elaeagnus angustifolia L. were selected as objects of study. 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 Elaeagnus angustifolia 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 mkm × 0.25 mkm).

Results. 23 compounds (1 in the isomeric state) in fruits and 20 compounds (2 in the isomeric state) in the leaf of Elaeagnus angustifolia L. were identified. The main components of fruits were sitosterol (phytosterols) – 12.53 %, propyl acetate (esters of carboxylic acids) – 12.60 %, chamazulene (terpenes) – 11.97 % and palmitic acid (fatty acids) – 8.28 %. The main component of leaves were sitosterol (phytosterols) – 17.57 %, 1-(2-hydroxy-5-methylphenyl)-ethanone (ketone) – 8.35 %, phytol (terpenes) – 6.10 %. It is known from the literature that chamazulene has antioxidant, antinociceptive, cytotoxic activity. Sitosterol is characterized by a wide range of biological action – antimicrobial, antinociceptive, anti-inflammatory, antioxidant and cytotoxic.

Conclusions. Based on the above, the olive can be considered as a source of antimicrobial, antinociceptive, anti-inflammatory, antioxidant, anti-diabetic and cytotoxic drugs.

Key words: Elaeagnus angustifolia, GS-MS, antimicrobial action, antidiabetic action, antinociceptive action, cytotoxic action, anti-inflammatory action, biological activity.

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Висновки. Маслину вузьколисту можна вважати джерелом протимікробних, антиноціцептивних, протизапальних, антиоксидантних, протидіабетичних і цитотоксичних препаратів.

Ключові слова: маслинина вузьколиста, GS-MS, протимікробна дія, протидіабетична дія, антиноціцептивна дія, цитотоксична дія, біологічна активність.

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Хромато-масс-спектроскопическое исследование химического состава лоха узколистного *Elaeagrus angustifolia* L.

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Цель работы — хромато-масс-спектроскопическое исследование химического состава лоха узколистного плодов и листьев, определение перспектив применения этого растения в медицине.

Материалы и методы. Объекты исследования — лоха узколистного плоды и листья. Настойка получена методом мацерации, сырье экстрагировали метиловым спиртом при комнатной температуре в течение 10 дней в соответствии с методикой изготовления настоя. Химический состав *Elaeagrus angustifolia* L. изучен 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. Идентифицировали 23 соединения (одно в изомерном состоянии) в плодах и 20 соединений (два в изомерном состоянии) в листьях лоха узколистного. Основные компоненты плодов: ситостерол (фитостероны) — 12,53 %, проил ацетат (эфиры карбоновых кислот) — 12,60 %, хамазулен (терпены) — 11,97 %, пальмитиновая кислота (жирные кислоты) — 8,28 %, фитол (терпены) — 6,10 %. Известно, что хамазулен обладает противовоспалительной и противодиабетической активностью, гексадекановая (пальмитиновая) кислота обладает противовоспалительными, гиполипидемическими и антиоксидантными свойствами. Для фитола характерен широкий спектр биологической активности: противомикробная, антиоксидантная, цитотоксическая, противовоспалительная, антиоксидантная и цитотоксическая.

Выводы. Лох узколистный можно считать источником противомикробных, антиноціцептивных, противовоспалительных, антиоксидантных, противовоспалительных, антиксидантных, противодиабетических и цитотоксических препаратов.

Ключевые слова: лох узколистный, противомикробное действие, противовоспалительные средства, антиоксидантное действие, цитотоксическое действие, противовоспалительное действие, биологическая активность.

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The family *Elaeagnaceae* includes about 80 species of plants [1]. In forms of life, these are deciduous trees and shrubs, less often vines, which grow mainly in Western Europe, Asia Minor, Central, and Southeast Asia, the Far East, and North America [2]. These plants play a very important ecological role and are used in folk medicine in some eastern countries [3]. Of note is the narrow-leaved olive *Elaeagnus angustifolia* L. Thus, Iranian researchers have proven the effectiveness of aqueous extract of olive fruit in the treatment of osteoarthritis [4,5]. Scientists from the Tehran University of Medical Sciences have described the cardioprotective, antioxidant, analgesic, antitumor, and anti-inflammatory effects of olive extracts [6]. These data are confirmed by studies of a team of American and Iranian scientists [7]. Other Iranian scientists have studied the antioxidant effect and considered the possibility of using olives as a biological additive of probiotic nature [8].

However, it was not revealed sufficient information on the chemical composition of *Elaeagnus angustifolia* L. in the literature. Therefore, research in this area is expedient and relevant.

**Aim**

The purpose of our work is to study the chemical composition of olives of narrow-leaved fruits and leaves by chromato-mass spectroscopic and to catch out on further promising applications of this plant in medicine.

**Materials and methods**

The object of the study was fruits and leaves of narrow-leaved olives. Raw materials were collected in August 2020 during the flowering and fruiting phase (Zaporizhzhia, Vyryva tract).

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 [9].

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 – PhD, DSc, 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. 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.
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Results
According to the results of the study, 23 compounds (1 in the isomeric state) in fruits and 20 compounds (2 in the isomeric state) were identified in the leaf of Olive narrow-leaved (Tables 1, 2), which by chemical structure belong to different classes of organic substances. The largest part in the chemical composition of fruits, was esters of carboxylic acids (5 compounds, 24.32 %), heterocyclic compounds (5 compounds, 14.53 %), phytosterols (1 compound, 12.53 %), terpenes (1 compound, 11.97 %).

The main components of fruits were sitosterol (phytosterols) – 12.53 %, propyl acetate (esters of carboxylic acids) – 12.60 %, chamazulene (terpenes) – 11.97 % and palmitic acid (fatty acids) – 8.28 %.

Table 1. Qualitative and quantitative composition of biologically active substances of Elaeagnus angustifolia L. fruit

| RT, min | Compound label | Area sum % |
|---------|----------------|------------|
| 1. 1.699 | Acetic acid, methyl ester | 2.02 |
| 2. 1.956 | n-Propyl acetate* | 10.44 |
| 3. 2.087 | 2-Propenoic acid, ethenyl ester | 1.19 |
| 4. 2.135 | n-Propyl acetate* | 2.16 |
| 5. 2.247 | Propanoic acid, 2-oxo-, methyl ester | 7.34 |
| 6. 3.183 | 2-Amino-1,3-propanediol | 5.99 |
| 7. 3.514 | 1,2-Cyclopentanediolone | 2.99 |
| 8. 4.325 | 2-Hydroxy-gamma-butrolactone | 5.72 |
| 9. 4.917 | (E, S)-2-Hexenoic acid, 4-amino-5-methyl-, methyl ester | 1.17 |
| 10. 5.137 | Furanol | 2 |
| 11. 5.414 | Maltol | 1.16 |
| 12. 5.73 | sec-Butyl nitrite | 1.89 |
| 13. 6.244 | L-Alanine, N-methoxycarbonyl-, tridecyl ester | 1.14 |
| 14. 6.418 | 4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl- | 6.97 |
| 15. 7.028 | 5-Hydroxymethylfuran-2-one | 1.44 |
| 16. 7.135 | Catechol | 1.18 |
| 17. 8.029 | 1,2-Benzenediol, 3-methyl- | 1.68 |
| 18. 8.608 | trans-2-undecenoic acid | 1.75 |
| 19. 10.521 | d-Glycero-d-galacto-heptose | 3.59 |
| 20. 14.001 | Chamazulene | 11.97 |
| 21. 16.248 | n-Hexadecanoic acid | 8.28 |
| 22. 17.21 | Pyridine, 4-(3-mercapto-4-methyl-5-(4H-1,2,4-triazolyl))- | 2.96 |
| 23. 17.934 | Octadec-9-enoic acid | 2.42 |
| 24. 22.312 | gamma.-Sitosterol | 12.53 |

Table 2. Qualitative and quantitative composition of biologically active substances of Elaeagnus angustifolia L. leaves

| RT, min | Compound label | Area sum % |
|---------|----------------|------------|
| 1. 1.713 | D-Alloisoleucine | 2.3 |
| 2. 1.959 | Isopropyl acetate | 2.13 |
| 3. 4.342 | 2-Octyn-1-ol, 7-[(tetrahydro-2H-pyran-2-y1)oxy]- | 1.73 |
| 4. 5.561 | 4-Heptanol, 4-ethyl-2,6-dimethyl- | 2.25 |
| 5. 7.467 | Benzofuran, 2,3-dihydro- | 5.99 |
| 6. 8.762 | Ethanol, 1-(2-hydroxy-5-methylphenyl)- | 8.35 |
| 7. 10.557 | d-Glycero-L-gluco-heptose | 1.87 |
| 8. 11.094 | beta.-D-Glucopyranose, 1,6-anhydro- | 3.94 |
Cont. of table 2.

| RT, min | Compound label                                                                 | Area sum % |
|---------|---------------------------------------------------------------------------------|------------|
| 9.      | Ethanone, 1-(3,4-dimethoxyphenyl)-                                               | 3.44       |
| 10.     | Myo-Inositol, 2-C-methyl-                                                         | 5.43       |
| 11.     | 2-Pentadecanone, 6,10,14-trimethyl-                                             | 5.5        |
| 12.     | 2-Pentanone, 4-(1,3,5-trimethyl-7-oxabicyclo[4.1.0]hept-2-yl)-                   | 2.79       |
| 13.     | n-Hexadecanoic acid                                                             | 5.23       |
| 14.     | Phytol                                                                          | 6.1        |
| 15.     | Oleic Acid*                                                                     | 2.21       |
| 16.     | Oleic Acid*                                                                     | 1.79       |
| 17.     | 4,8,12,16-Tetramethylheptadecan-4-oxide                                          | 1.76       |
| 18.     | Stigmasterol                                                                    | 3.27       |
| 19.     | 9,19-Cyclolanost-7-en-3-ol                                                       | 2.92       |
| 20.     | .gamma.-Sitosterol                                                              | 17.57      |
| 21.     | alpha.-Tocospiro A*                                                             | 4.37       |
| 22.     | alpha.-Tocospiro A*                                                             | 3.76       |

*: these compounds are believed to be isomers.

Fig. 1. Chromatogram of *Elaeagnus angustifolia* L. fruit’s components.

Fig. 2. Chromatogram of *Elaeagnus angustifolia* L. leaves’ components.
The chemical composition of the leaves slightly differed: the main share belonged to phytosterols (2 compounds, 20.87 %), ketones (4 compounds, 20.08 %), and terpenes (2 compounds, 14.23 %).

The main component of the leaves was sitosterol (phytosterols) – 17.57 %, 1-(2-hydroxy-5-methylphenyl)-ethanone (ketone) – 8.35 %, phytol (terpenes) – 6.10 %.

The chromatogram of fruit components (Fig. 1) was identified sitosterol (RT = 22.312), palmitic acid (RT = 16.248), chamazulene (RT = 14.001), propyl acetate (RT = 1.956).

The chromatogram of leaves components (Fig. 2) was identified sitosterol (RT = 22.316), oleic acid (RT = 17.934), palmitic acid (RT = 16.240).

**Discussion**

According to the literature chamazulene has antioxidant [10] and antinociceptive activity [11]. Italian scientists have studied its effects on human melanoma cells, in which it was found that plants rich in chamazulene were particularly active against cancer cells, causing their death [12].

Sitosterol is characterized by anti-inflammatory activity [13,14]. Japanese scientists have examined its ability to inhibit chronic inflammation associated with obesity [15]. Based on the data obtained, it was concluded that sitosterol can be used to treat metabolic diseases, in particular diabetes [16].

Hexadecanoic (palmitic) acid has antimicrobial [17], antioxidant properties and can also be used in the treatment of diabetes [18].

Phytol is characterized by a wide range of biological activity, that is antimicrobial, antinociceptive, anti-inflammatory, antioxidant, and cytotoxic [19,20].

Based on the research, the olive can be considered as a source of antimicrobial, antinociceptive, anti-inflammatory, antioxidant, and cytotoxic medicines. Also, it can be considered useful in the treatment of diabetes.

**Conclusions**

1. For the first time the chemical composition of olive-leaved fruits and leaves was established with GS/MS.

2. According to the results of the study, 23 compounds (1 in the isomeric state) in fruits and 20 compounds (2 in the isomeric state) were identified in the leaf of Olive narrow-leaved, which by chemical structure belong to different classes of organic substances.

3. The main components of fruits were sitosterol (phytosterols) – 12.53 %, propyl acetate (esters of carboxylic acids) – 12.60 %, chamazulene (terpenes) – 11.97 % and palmitic acid (fatty acids) – 8.28 %. The main component of the leaves was sitosterol (phytosterols) – 17.57 %, 1-(2-hydroxy-5-methylphenyl)-ethanone (ketone) – 8.35 %, phytol (terpenes) – 6.10 %.

4. Olive narrow-leaved can be recommended for further research on antimicrobial, antinociceptive, anti-inflammatory, antioxidant, and cytotoxic, antidiabetic activity.

**Prospects for further research.** Olive narrow-leaved fruits and leaves can be considered as a potential source of antimicrobial, antinociceptive, anti-inflammatory, antioxidant, cytotoxic, and antidiabetic drugs.

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