O‘ZBEKISTON MILLIY UNIVERSITETI XABARLARI, 2025, [3/1]
ISSN 2181-7324

KIMYO
http://journals.nuu.uz
Natural sciences

UDK: 547.918:547.926

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PhD O.Mamazhanov's based on review

TERPENOIDS, CHEMICAL COMPOSITION OF ESSENTIAL OIL AND ANTIMICROBIAL ACTIVITY OF *FERULA FERGANENSIS* ROOT

Annotation

Continuing the study of the chemical composition of the *Ferula ferganensis* plant, terpenoids were isolated from the root using silica gel KSC and column chromatography from the chloroform fraction. The sesquiterene esters of three carotenoids were isolated from the chloroform fraction with a mixture of benzene and ethyl acetate (25:1-6:1) and analyzed hexane fraction by GC and GC/MS to determine the composition of the volatile ester, and 63 components were identified. This study revealed that the ether oil of *F. ferganensis* contains biologically active substances, especially antimicrobial agents.

Key words*:* *Ferula ferganensis*; Essential oil; Antibacterial activity; Antifungal activity; KSC, GC-MS.

ТЕРПЕНОИДЫ, ХИМИЧЕСКИЙ СОСТАВ ЭФИРНОГО МАСЛА И АНТИМИКРОБНАЯ АКТИВНОСТЬ КОРНЯ FERULA FERGANENSIS

Аннотация

Продолжая изучение химического состава растения Ferula ferganensis, терпеноиды были выделены из корня с использованием силикагеля КСХ колоночной хроматографии из хлороформной фракции. Сесквитереновые трех каротиноидов были выделены из хлороформной фракции смесью бензола и этилацетата (25:1-6:1) и проанализированы гексановой фракцией с помощью ГХ и ГХ/МС для определения состава летучего эфира, и были идентифицированы 63 компонента. В ходе данного исследования было выявлено, что эфирное масло F.ferganensis содержит биологически активные вещества, особенно антимикробные агенты.

Ключевые слова: *Ferula ferganensis*; Эфирное масло; Антибактериальная активность; Противогрибковая активность; КСХ, ГХ-МС.

FERULA FERGANENSIS ILDIZ QISMINING TERPENOIDLARI, UCHUVCHAN EFIR MOYINING KIMYOVIY TARKIBI VA MIKROBLARGA QARSHI FAOLLIGI

Annotatsiya

Ferula ferganensis o‘simligining kimyoviy tarkibini o‘rganishni davom ettirib, xloraformli fraktsiyasidan silikagel KSX ustunli xromatografiya yordamida ildizdan terpenoidlar ajratib olishga erishildi. Xloraformli fraktsiya, benzin va etil asetat aralashmasi (25: 1-6: 1) da uchta karotenoidning sesquiterpen qatori murakkab efirlari ajratib olingan va uchuvchan efiri tarkibini aniqlash uchun geksan fraktsiyasidan GC va GC / MS tomonidan tahlil qilinib, 63 ta komponent aniqlandi. Ushbu tekshirishda F.ferganensisning efir moyi tarkibida biologik faol moddalar, ayniqsa mikroblarga qarshi vosita borligi aniqlandi.

Kalit so‘zlar: *Ferula ferganensis*, Efir moyi, Antibakterial faollik, Antifungal faollik, KSX, GC-MS.

Introduction. The medicinal properties of the genus *Ferula* (Family *Apiaceae*) have a long history [1]. To date, *Ferula* has been traditionally used in many countries to treat stomach pain, flatulence, intestinal diseases, and asthma [2, 3, 4, 5]. *Ferula* plants are rich in chemical composition consisting of sesquiterpenes [6], coumarins, and rolsulfanes, which have unique properties and are highly biologically active [7, 8, 9, 10, 11, 12]. However, for many species, only a few studies have determined their chemical composition and safety mechanisms. This remains the basis for further research for discovery.

Literature reviews. Literature review: Many scientists have reported more than 180 chemical components, terrenoids, coumarins, and sesquiterpene coumarins. Recently, many new secondary metabolites have been discovered in the genus *Ferula*, which belong to different classes of natural biological changes. The from different biological activities substances anti-inflammatory and neuroprotective [13]. The chemical compounds of essential oils obtained from different *Ferula* species have shown many biological activities. Due to the presence of many biologically active substances, such as antimicrobial, insecticidal,

antioxidant, cytotoxic, etc., researchers are currently focusing on this area [141]. The chemical compounds of *F. ferganensis*, the essential oils extracted from its fraction and the biological activities were investigated for the first time in this study.

Research methodology: Search for biologically active compounds. Determination of the chemical composition of essential oils in the underground part of *F. ferganensis*.

Materials and methods

The chemical composition of volatiles of the hexane fraction of the root part of *F. ferganensis* collected from the Ola-Too ridge in the Suusamur valley of the Kyrgyz Republic in mid-June 2021 was determined by GC-MS. Gas Chromatography (GC) and Gas Chromatography-Mass Spectrometry (GC-MS)

The qualitative and quantitative characteristics of the essential oil were determined on an Agilent 5975C inert MSD/7890A GC-MS (Agilent Technologies, USA). The components of the mixture were adsorbed onto an Agilent NR-INNOWah quartz column (30 μm × 250 μm × 0.25 μm). The GC-MS analytical results were consistent with the literature data [16]. The components were identified based on the data from electronic libraries. The mixture of n-alkanes (C9–C20) and their interactions with mass fragments were determined based on the retention time ratio. [16, 17].

Antibacterial activity

The disk diffusion method was used to determine the biological activity of the essential oil against specific strains of microbes using test strains *(B. subtilis-5S, aureus-91, R. aeruginosa-225, E. coli-221, C. albicans-247)* [18].

Analysis and results: The essential oil of the underground part of *F. ferganensis* was analyzed by GC-MS and contained 63 components, accounting for 42.43% of the essential oil. Monoterrene hydrocarbons (5.3%), oxidized sesquiterrene hydrocarbons (14.74%), and oxidized sesquiterrene (4.62%). Other substances were only (14.74%).

The quantitatively dominant main composition of the essential oil (Fig .1.) *p*-Anisic acad (4.66%), Verbenone (2.82%), 7,8-Epoxy-*α*.-ionone (2.42%), Vanillin (1.20%), Cyclo *iso*-longifolene, 8,9-dehydro (1.80%), (+)-Valencene (0.95%), *o*-Cymene (0.92%), Mentha-1,4,8-triene (0.92%), *.α.*-Elemene (0.86%), *α.*-Guaiene (0.90%), *.β.*-Humulene (0.86%), Widdrene (0.86%), Aristolan-1(10)-en-9-ol (0.82%),

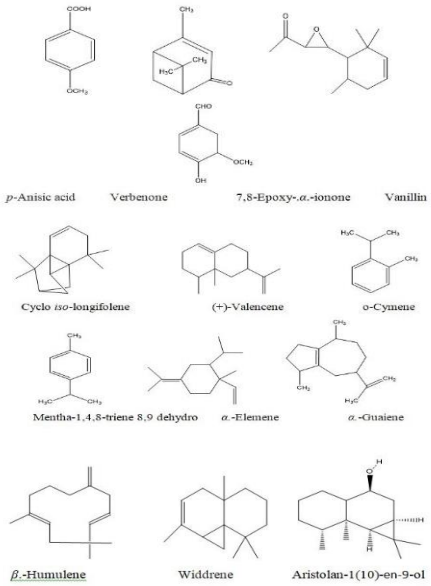

Fig .1. Structural formula of the quantitatively dominant main components of the *F. ferganensis* essential oil

Table 1.

Qualitative and quantitative composition of essential oil in the root part of *F. ferganensis*

Constituent	RI	Content %	Constituent	RI	Content %
1-Butanol	1145	0.56	Ledene	2304	0.34
1,8-Cineole	1327	0.19	(-)-Caryophyllene-(I1)	2307	0.36
Acetic acid	1565	0.25	7,8-Epoxy-. α.-ionone	2318	2.42
3-Cyclohexen-1-ol	1588	0.16	4.10(14)-Cadinadien-8. β.-ol	2326	0.16
(-)-Myrtenal	1601	0.19	Alloaromadendrene	2344	0.45
(1R)-(+)-α-Pinene	1632	0.29	Benzaldehyde,3,4-dimethoxy-	2354	0.28
Mentha-1,4,8-triene	1659	0.91	. β.-Humulene	2366	0.86
Verbenone	1676	2.82	Epiglobulol	2386	0.39
Borneol	1681	0.24	Valencene	2401	0.18
Camphene	1684	0.15	Dehydroaromadendrene	2456	0.48
E-2-Caren-4-ol	1729	0.20	β.-Sitosterin	2477	0.19
Delta-cadinene	1745	0.27	2,4,5-Trimethoxybenzaldehyde	2489	0.22
o-Cymene	1828	0.92	(+)–Aromadendrene	2498	0.62
Phenol	1982	0.21	Vanillin	2509	1.20
Valerenol	2019	0.29	Alloaromadendrene	2521	0.70
γ-Gurjunene	2063	0.13	Calarene epoxide	2584	0.58
Oprea1_	2095	0.16	Valencene	2610	0.76
Z-α-Copaen-8-ol	2111	0.17	Widdrene	2617	0.86
Cycloisolongifolene, 8,9-dehydro-	2149	1.80	Vellerdiol	2631	0.38

γ-Elemene	2155	0.86	Azulene	2641	0.96
Junipene	2167	0.32	3-Ethoxy-4-methoxybenzaldehyde	2652	0.96
Valencene	2176	0.95	3-Cyclohexen-1-ol	2662	0.85
.γ.-Muurolene	2180	0.69	Ledene oxide-(II)	2797	0.44
Aristolan-1(10)-en-9-ol	2185	0.82	*p*-Anisic acad	2814	4.66
. β.-Selinen	2198	0.14	Falcarinol	2866	0.41
.α.-Gurjunene	2204	0.15	Methylchromone	2965	0.27
.tau.-Cadinol	2110	0.33	1-(Trichlorosiloxy) cyclohexene	2969	0.27
Dehydroaromadendrene	2217	0.69	1,3-Cyclohexanedione	3072	5.67
. β.-Selinen	2221	0.27	. β.-Vatirenene	3535	0.49
Naphtalene	2226	0.33	Monoterpene hydrocarbons		5.33
. β.-Vatirenene	2252	0.32	Oxidized monoterpenes		3.0
. α.-Guaiene	2255	0.90	Sesquiterpene hydrocarbons		14.74
4,9-Undecadiyn-1-ol	2291	0.30	Oxidized sesquiterpene		4. 62
.α.-Longipinene	2295	0.56	Predominates, and other substances		14.74
Total	42.43%				

GC-MS analytical results showed that the hexane fraction of the underground part of *Ferula ferganensis* was rich in content.

Antimicrobial activity of essential oil. A comprehensive test strain of the essential oil was carried out against selected test strains. It inhibited the growth of *E. coli* 12±1.3 mm, *B. subtilis* 14±1.0 mm, *P. aeruginosa* 16±0.41; *S. aureus* 15±1.2; *C. albicans* 17±1.3, strains (Fig. 2). It showed highly effective antimicrobial activity (Table 2)

Table 2.

Antibacterial activity of essential oil from *F.ferganensis* flowers

Sample	**Inhibition zone diameter (mm)**				
	B. subtilis	*S. aureus*	*P. aeruginosa*	*E. coli*	*C. albicans*
Essential oil	14±1.0	15±1.2	16±0.41	12±1.3	17±1.3
Canamycin	18±0.11	16±0.13	20±0.11	21±0.12	22±00
DMSO	6±0.13	5.0±01	5.0±02	9.0±03	8.4±0.14

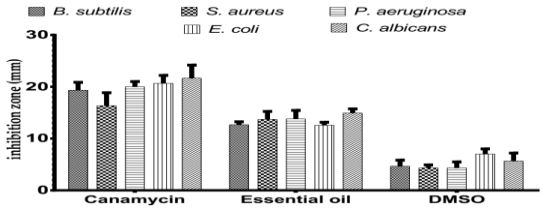

Fig 2. Antimicrobial activity of essential oils of *F.ferganensis*

The chloroform fraction of the underground part of *Ferula ferganensis* was separated by silica gel column chromatography, using a mixture of benzene and ethyl acetate (25:1-6:1). The chemical structure of the isolated compounds was established based on ^{1}N, ^{13}C NMR spectral data and comparison with those in the literature. Sesquiterene esters of three carotenoids were isolated (Fig. 3).

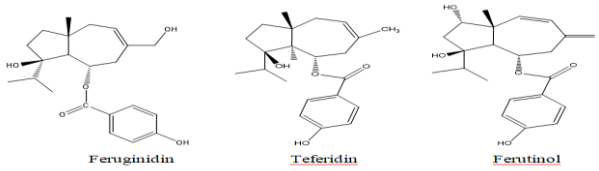

Fig. 3. Substances derived from the plant *Ferula ferganensis*

Conclusion. The chemical composition of the hexane fraction of the root of *F. ferganensis* was studied for the first time by GC-MS.

F. ferganensis showed broad-spectrum activity against selected test strains. For the first time, its antimicrobial activity was studied.

Feruginidine, teferidine, and ferutinol were first time isolated from the root of the *Ferula ferganensis* plant.

Gratitude. The work was carried out with the financial support of the Foundation for International Cooperation in Science and Technology. Project Academy of Sciences of the Republic of Uzbekistan (Grant MUK-2021-38 and MUK-2021-39).

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