Original article

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EVALUATION OF BIOLOGICAL ACTIVITY OF *FERULA TATARICA* FISCH. EX SPRENG. FOR DETERMINATION OF PHARMACEUTICAL POTENTIAL

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ABSTRACT

The article presents scientific information aimed at addressing the challenges of establishing the pharmaceutical potential of *Ferula tatarica* Fisch. ex Spreng, selected from forb-cereal-meadow phytocenoses in the ecosystems of Northern Kazakhstan. This species is widely used in folk medicine and requires an assessment of its antibacterial, antifungal, and anthelmintic activities. The object of the study is *Ferula tatarica* samples in the flowering phase, along with plant extracts. Preparation and analysis of extracts in accordance with the State Pharmacopoeia of the Republic of Kazakhstan; analysis of antimicrobial and antifungal properties using serial dilution in agar and disk diffusion; assessment of anthelmintic properties on *Lumbricus terrestris*. The study also covers the distribution of *Ferula tatarica* in Northern Kazakhstan and the coenopopulation of the *Ferula*-timothy (*F. tatarica*, *Phleum pratense*) phytocenosis in the Akmola region. The antimicrobial activity of aqueous infusions of the underground and aboveground parts of *Ferula tatarica* against the tested microorganisms – *E. coli*, *C. papapsilosis*, and *Aspergillus niger* – was revealed. The activity of oil and water-alcohol extracts of *Ferula tatarica* was also noted against the opportunistic mold fungus *Aspergillus* spp. Anthelmintic properties were found in oil, water-alcohol, and water extracts, as these affected the behavior and caused the death of *Lumbricus terrestris*. The greatest effect and the most rapid death of annelids were induced by alcohol tinctures, while oil extracts showed the least effect. *Ferula tatarica* is present in the coenopopulation of the *Ferula*-timothy (*F. tatarica*, *Phleum pratense*) phytocenosis in the Akmola region of Northern Kazakhstan. Water infusions of the underground and aboveground parts of *Ferula tatarica* exhibit pronounced antimicrobial activity against *E. coli*, *C. papapsilosis*, and *Aspergillus niger*. Oil and water-alcohol extracts show activity against *Aspergillus niger*. Furthermore, oil, water-alcohol, and water extracts demonstrate anthelmintic properties, altering the behavior and causing the death of *Lumbricus terrestris*. The observed biological activity of *Ferula tatarica* demonstrates its pharmaceutical potential, warranting further research on the species.

Keywords: *Ferula tatarica* Fisch. ex Spreng, habitat, extracts, bactericidal, fungicidal, anthelmintic properties, pharmaceutical potential.

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1 INTRODUCTION

Medicinal plants play a significant role in modern medicine, pharmacology, cosmetology, and the food and agricultural industries. In response to these global trends, healthcare organizations and the pharmaceutical industry in Kazakhstan are focusing on creating a raw material base for new and effective medicines derived from plant materials [1–3]. The vascular plant biodiversity of the republic includes approximately 7,000 species. Of these, 278 species are listed as medicinal plants in Kazakhstan, according to Order No. 77 of the Ministry of Ecology and Natural Resources, dated March 7, 2023, «On the Approval of the List of Medicinal Plants».

Among the numerous medicinal plant species in Kazakhstan, *F. tatarica* is particularly notable. The genus *Ferula* is represented by 51 species in the republic, 15 of which are classified as endemic, including *F. glaberrima* Korovin., *F. tersakensis* Korovin., *F. popovii* Korovin., *F. iliensis* Krasn. ex Korovin., *F. leiophylla* Korovin, *F. pachyphylla* Korovin., *F. ceratophylla* Regel & Schmalh., *F. potaninii* Korovin ex Pavlov., *F. macrocarpa Hook. & Arn.* , *F. xeromorpha* Korovin., *F. ldulata* (Bunge) Regel, *F. leucographa* Korovin., *F. involucrate* L., *F. gypsacea* Korovin., *F. eremophila* Korovin.. Additionally, 15 species are used in folk medicine, including *F. assa-foetida* L., *F. capsica* M. Bieb., *F. diversivittata* Regel & Schmalh., *F. ferulaeoides* (Steud.) Korovin, *F. iliensis*

Krasn. ex Korovin., *F. karelinii* Bunge, *F. pallid* Korovin., *F. penninervis* Regel & Schmalh., *F. sumbul* (Kauffm.) Hook. f, *F. songorica* Pall. ex Spreng., *F. schair I.G.Borshch*., *F. teterrima* H.Karst. & Kir., *F. transiliensis* (Herder) Pimenov., *F. tschimganica* Lipsky ex Korovin, *F. tenuisecta* Korovin., the chemical composition and nutritional value have been studied, revealing their potential as valuable forage plants [4–6].

Botanical studies conducted in the Central Kazakh Upland (CKU) have shown the presence of *F. caspica* in the fine wormwood-fescue-feather grass steppes, where it grows as a long-vegetating perennial. In the desert steppe zone, *F. tatarica*, *F. ferulaeoides*, and *F. soongarica* have been identified. In the feather grass associations of the eastern part of the Central KM (near Kyzylray city), *F. tatarica* and *F. caspica* were observed among the hemiephemeroids. In the wormwood-tyrsika steppe between the Karsakpai Plateau and Pribalkhash, *F. ferulaeoides* is dominant, while *F. caspica* is considered a permanent species [7].

The morphological features of the vegetative part of *Ferula* are summarized, showing the average height (36.9 ± 7.26 cm), the width of the basal rosette of leaves (107.6 ± 22.45 cm), the total number of basal leaves (7.0 ± 1.71), and their width (63.4 ± 11.27 cm) and length (61.1 ± 9.86 cm), respectively. The length of the root system of *Ferula* was 204.2 ± 55.82 cm, and the length of the turnip-shaped rhizome was 33.4 ± 6.58 cm [8].

Species of the genus *Ferula*, common in India, have been studied in sufficient detail, revealing antioxidant, antiviral, antifungal, anticancer, antidiabetic, antispasmodic, hypotensive, and molluscicidal effects. Based on these findings, a comprehensive review of the pharmacological and biological properties of *F. asafoetida* was conducted [9]. Extracts of the resin, containing coumarins, furan and clerodane compounds, and sesquiterpenoids, were tested on laboratory animals. It was found that these extracts significantly suppressed the inflammatory process [10]. A series of experiments demonstrated that *F. asafoetida* (resin extracts) could serve as a potential source of anti-inflammatory and analgesic agents, with the effects attributed to its biologically active components, such as monoterpenes, flavonoids, and phenolic compounds that inhibit lipoxygenase activity [11].

During the flowering period, biologically active substances accumulate most actively in the stems and upper parts of the plant, while in its seeds, the accumulation occurs after ripening. Ointments and alcohol extracts from *Ferula* influenced the sexual products of laboratory animals and their estrogenic activity [12].

Due to the widespread use of *Ferula* species in folk medicine, their habitats are becoming increasingly restricted. *F. sadleriana* (Apiaceae) is a perennial herbaceous plant with a very limited range. It is listed as «endangered» in the Red List of the International Union for Conservation of Nature (IUCN) [13]. Thus, the presence of *Ferula* species in Northern Kazakhstan, along with their use in folk medicine, underscores the relevance of studying their biological properties.

The aim of this research was to investigate the antimicrobial and antiparasitic activity of wild populations of *F. tatarica*, in order to assess its pharmaceutical potential.

2 MATERIAL AND METHODS

For this study, samples of *F. tatarica* were collected from ecosystems in Northern Kazakhstan during the 2020 expedition. During plant sampling, the coordinates of the area were recorded, geobotanical descriptions were made, and samples were collected for subsequent laboratory analysis. On 10 × 1 m² plots, with 5 replicates, we determined the projective cover (%), total cover (%), abundance of the studied species according to the Drude abundance assessment scale, height of adult individuals (cm), number of generative individuals (pcs/m²), number of leaves per shoot (pcs), and the phenophase of the species. The methodological approaches followed those outlined in references [14, 15]. To establish morphometric characteristics, 10 plants were used [16, 17].

For laboratory analysis, plant samples were air-dried on shelves in an indoor environment. From the dried samples of *F. tatarica*, averaged samples were prepared by grinding both the aboveground and underground parts and thoroughly mixing them. Oil and water infusions, alcohol tinctures, and water decoctions were prepared from the mixed plant samples according to the State Pharmacopoeia of the Republic of Kazakhstan (2008) [18].

Infusions and tinctures were allowed to infuse for two weeks in a dark place, while decoctions were prepared immediately before use. The preparations were sterilized through filtration using filters with a pore diameter of 0.45 μm. The infusions, tinctures, and decoctions were stored at 2–8°C in a household refrigerator for no more than three days.

The antimicrobial properties of *F. tatarica*, specifically its antibacterial activity, were assessed using serial dilutions in agar and the disk diffusion method against *Escherichia coli* bacterial strains. The antifungal activity, specifically the minimum inhibitory concentration (MIC), was tested using similar methods against opportunistic pathogenic strains, including the yeast *Candida papapsilosis* and the mold fungus *A. niger*, obtained from the microorganism collection at the Laboratory of Mycology and Biotechnology of Fungi, KATIU named after S. Seifullin. For microbiological studies, nutrient media such as GRM-agar, Mueller-Hinton broth, and Sabouraud broth were prepared. Sterile and cooled nutrient media were mixed with working solutions of the extracts and poured into Petri dishes. Additionally, serial two-fold dilutions of each *F. tatarica* extract (native or 1:1, 1:2, 1:4, 1:8, 1:16, 1:32, etc., up to 1:256) were prepared in a volume of 4 ml. The extracts in various concentrations were then added to liquid nutrient media (broth) in test tubes, followed by the addition of *E. coli* microbial suspension.

The MICs of the plant extracts were determined using serial microdilution, preparing two-fold dilutions of *F. tatarica* extracts in the wells of 96-well plates. Test culture suspensions, standardized by optical density, were added to these wells at a final concentration of 10^6 cells/ml. The minimum inhibitory concentrations (MIC) of extracts from the aboveground parts and roots of *F. tatarica* were determined using the serial microdilution method. Eleven serial two-fold dilutions of the extracts were prepared in the wells of 96-well plates. Suspensions of the tested bacterial cultures, yeasts, and mold fungi spores, all standardized by optical density, were added at a final concentration of 10^6 cells/ml. The MIC was visually determined based on the absence of visible microbial growth in the wells. The MIC was calculated visually based

on the absence of visible microbial growth.

To determine the minimum bactericidal concentration (MBC), the extracts were serially diluted 1:2 in the wells of 96-well plates, followed by the addition of 10 µl of bacterial suspension, yeast cells, or *A. niger* spores. A bacterial suspension with a density corresponding to the turbidity standard 0.5 according to McFarland was used. To determine the MBC, 10 µl from each well was transferred onto a sector of solid nutrient medium after 24 hours of incubation, and the plates were then incubated for an additional 16-18 hours at 35°C. For transferring extracts from the 96-well plates onto agar, dilutions starting from 1:4 were used, as lower dilutions were excluded due to the lack of visible changes observed during the initial analysis of the wells.

The MIC was also determined by the disk diffusion method according to standard procedures [19, 20, 21, 22, 23].

The anthelmintic activity of *F. tatarica* was tested using a modified method on annelids – *Lumbricus terrestris* – which served as the test subjects. The behavior of the worms in Petri dishes on a solid nutrient medium with wells pre-filled with extracts was observed after 3, 6, and 12 hours on the first day, and every 8 hours during the following two days. Distilled water was used as a negative control, while a solution of piperazine citrate (20 mg/100 ml) served as the positive control [24]. The anthelmintic effect was evaluated based on the following indicators: natural worm behavior, the worms' tendency to approach or move away from the wells, the time of death, the presence and intensity of decomposition odor if death occurred, and the presence and degree of hemolysis. Each indicator was scored as follows: +++ (strongly pronounced), ++ (moderately pronounced), + (weakly pronounced), or «-» (absent). The total number of «+» signs was counted, and points were assigned accordingly [25]. As a negative control, the following solvents were used to prepare the corresponding extracts: water, ethyl alcohol, and vegetable oil. For the positive control, the herbal preparation «*Florateca Invasol*» was used – a natural biogenic complex based on microspheres of plant bioconcentrates, native oils, and natural components, which acts as an antiparasitic agent and includes, among other ingredients, a bioconcentrate of *F. dzhungarica*. Laboratory tests of antimicrobial and antiparasitic activity were performed in triplicate to ensure statistically significant results.The results of the biological activity analysis were interpreted using standard statistical methods.

3 RESULTS

F. tatarica is found in the regions of Northern Kazakhstan as part of forb-grass-meadow vegetation. The species' population areas have been recorded in the Akmola region, Zerenda district, near the village of Viktorovka, which lies within the State National Park «Kokshetau» in the Gribanovskoye forestry, plot 112, at coordinates 52º46'25.7» N, 69º04'05.7» E, and at an elevation of 1531 meters above sea level. The area's relief is characterized as level with slight undulations. The ground cover is well-developed, measuring 2–2.5 cm in thickness. The total projective cover at the time of the survey was 98%. *F. tatarica* is a perennial polycarpic plant, growing to a height of 30–70 cm, with a non-thickened taproot. In Kazakhstan, *F. tatarica* is found in the spurs of the General Syrt, as well as in the Tobol-Ishim and Irtysh basins. It is also observed in the Aktobe region, within the territory of the Mugodzhar Mountains, Turgay, and the western part of the Central Kazakh Uplands, Ulytau Mountain, and Betpakdala. (Flora of Kazakhstan, 1956–1966, Volume 6). Its general distribution includes West Siberia (Kurgan region), South Eastern Europe, Ciscaucasia, and Kazakhstan [26].

Based on the ecological and phytocenotic structure of the community, one distinct phytocenosis is identified and described. The coenopopulation of the *F. tatarica*-timothy (*Phleum pratense*) phytocenosis is widespread on meadow chernozems. This community typically contains other meadow herbs, including *Sanguisorba officinalis*, *Filipendula ulmaria*, *Serratula coronata*, *Thalictrum simplex*, *Achillea millefolium*, *Taraxacum officinale*, *Fragaria viridis*, *Lathyrus gmelinii*, *Phlomoides agraria*, and, more rarely, *Iris sibirica*. In some depressions, mesohygrophytic vegetation such as *Ranunculus acris* and *Juncus gerardii* is present. This area is subjected to annual mowing for hay production, which negatively affects the species' seed reproduction. *F. tatarica* plants are diffusely distributed across the population area in the form of extensive microcenoses. At the time of the survey (May 28), the species was in the vegetative phase and had not yet formed generative organs or reached its maximum growth. The population, which covers approximately 25 hectares, occupies large areas in depressions and between tufts. The age spectrum is dominated by adult generative in-

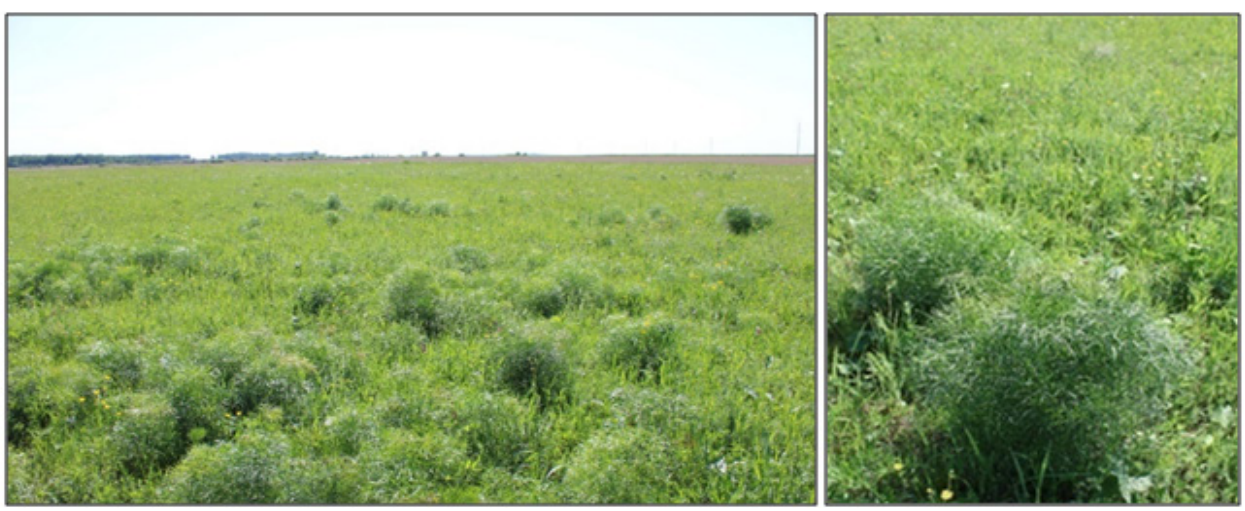


Figure 1 – Population of *Ferula tatarica*. (Photo by S.A. Kubentaev)

Table 1 – Minimum inhibitory bactericidal and fungicidal concentration of extracts of *F. tatarica.*

Ferula tatarica	Oil extracts	Hydroalcoholic extracts	Water extracts	Water infusions
against bacterium *E. coli*				
Aboveground part	-	-	1:8	-
Underground part	-	-	1:2	-
Control	-	-	-	-
against *C. parapsilosis* yeast				
Aboveground part	-	-	1:2	-
Underground part	-	-	-	-
Control	-	-	-	-
against *A. niger* mold fungi				
Aboveground part	-	1:2	-	-
Underground part	1:8	-	1:4	-
Control	-	-	-	-

dividuals. At the time of the description, the height of adult individuals averaged 54.12 ± 1.33 cm. The number of generative individuals was 2,4 ± 0.62 individuals/m², with an average of 32.1 ± 1.70 shoots per individual. Each shoot had an average of 3.5 ± 0.74 leaves (Figure 1).

Figure 1 shows the general appearance of the population and several individuals of *F. tatarica* in its growing areas. The air-dry root mass yield was 76.44 kg/ha, with the operational reserve reaching approximately 1.9 tons.

An analysis of the antibacterial activity of the above-ground parts and roots of *F. tatarica* Fisch. ex Spreng against *Escherichia coli* (*E. coli*) yielded notable results (Table 1).

As shown in Table 1, oil and water-alcohol extracts of *F. tatarica* did not exhibit bactericidal activity against *E. coli* or fungicidal activity against *C. papapsilosis*. However, unexpectedly, extracts of *F. tatarica* demonstrated activity against opportunistic mold fungi *A. niger*. Water infusions of both the underground and above-ground parts of *Ferula tatarica* were active against all tested microorganisms, although their suppressive capacity was not high. Interestingly, water decoctions of *F. tatarica* showed no activity against any of the microorganisms tested.

The presence of antibacterial and antifungal activity allowed for the determination of the minimum inhibitory concentration (MIC) of the extracts. Figure 2 illustrates that the absence of antimicrobial activity in the extracts results in rapid proliferation of bacteria and micromycetes in the wells, leading to turbidity of the medium.

The results of the antimicrobial activity of aqueous extracts of *F. tatarica* allowed for the identification of their minimum bactericidal concentrations (MBC). The delay or ab-

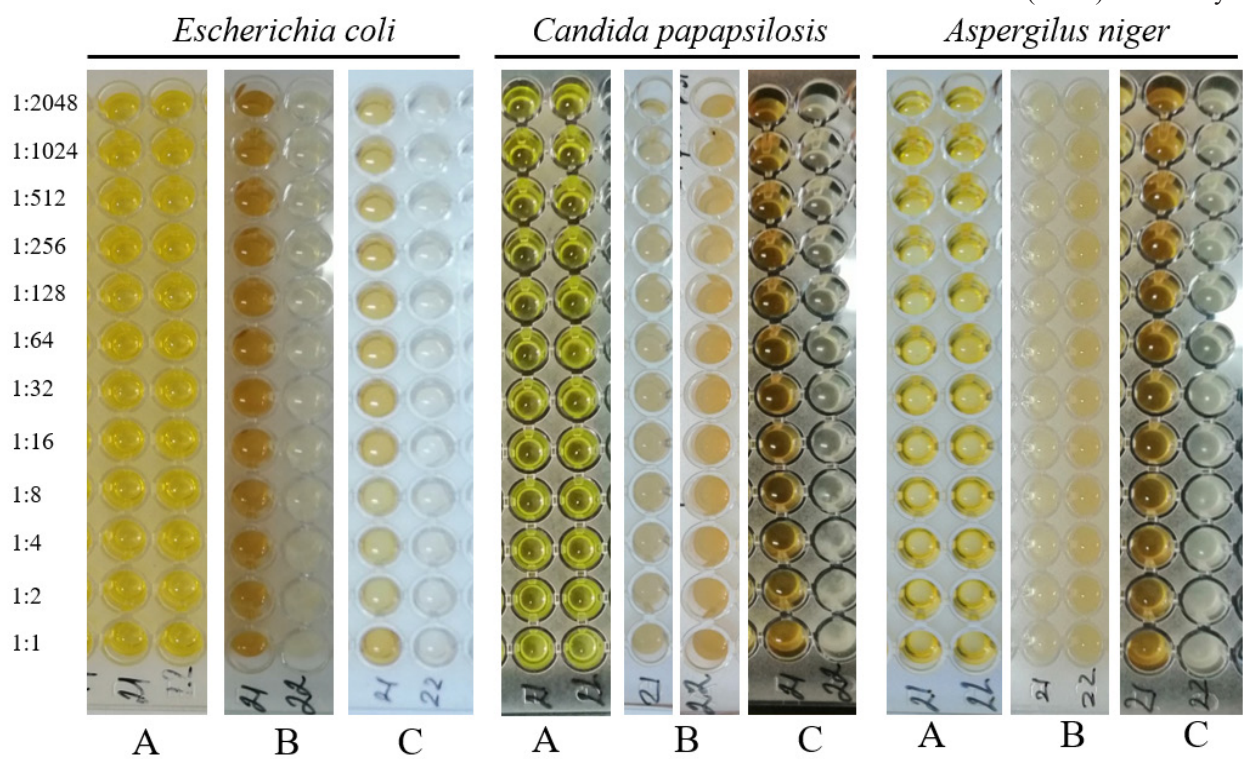


Figure 2 – Visual manifestation of minimum inhibitory concentrations of extracts of the above-ground part (21) and roots (22) of *F. tatarica*: A – oil extract, B – alcohol extract, C – water extract.

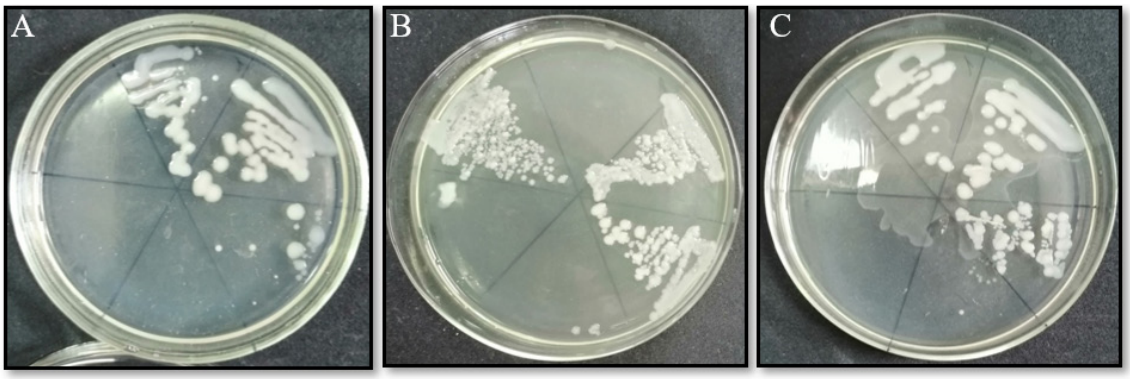


Figure 3 – Results of the detection of the minimum bactericidal concentration (MBC) of aqueous extracts of *F. tatarica*: A – *E. coli*, B – *C. papapsilosis*, C – *A. niger*.

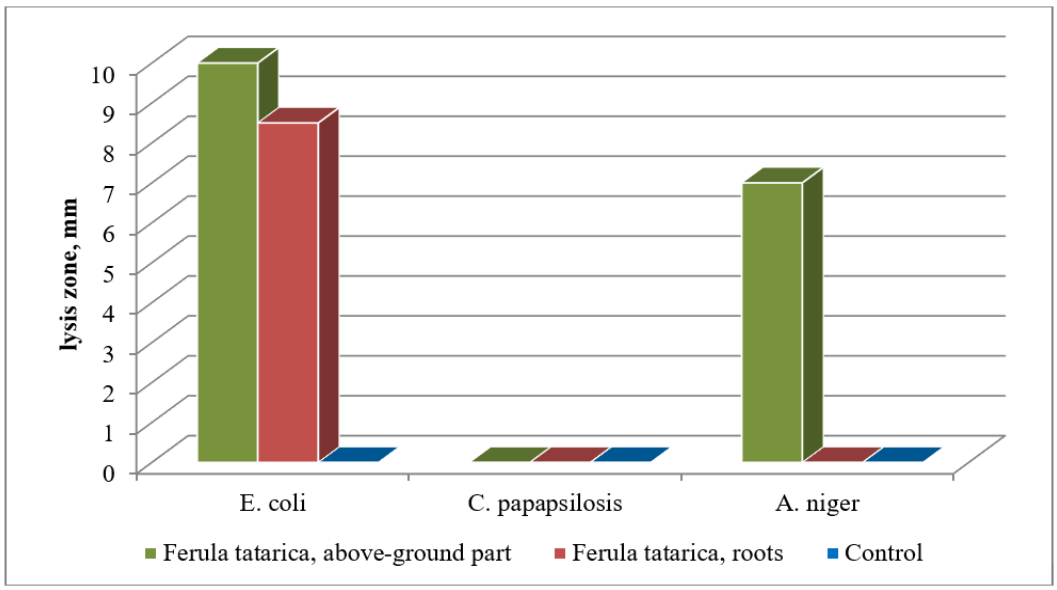
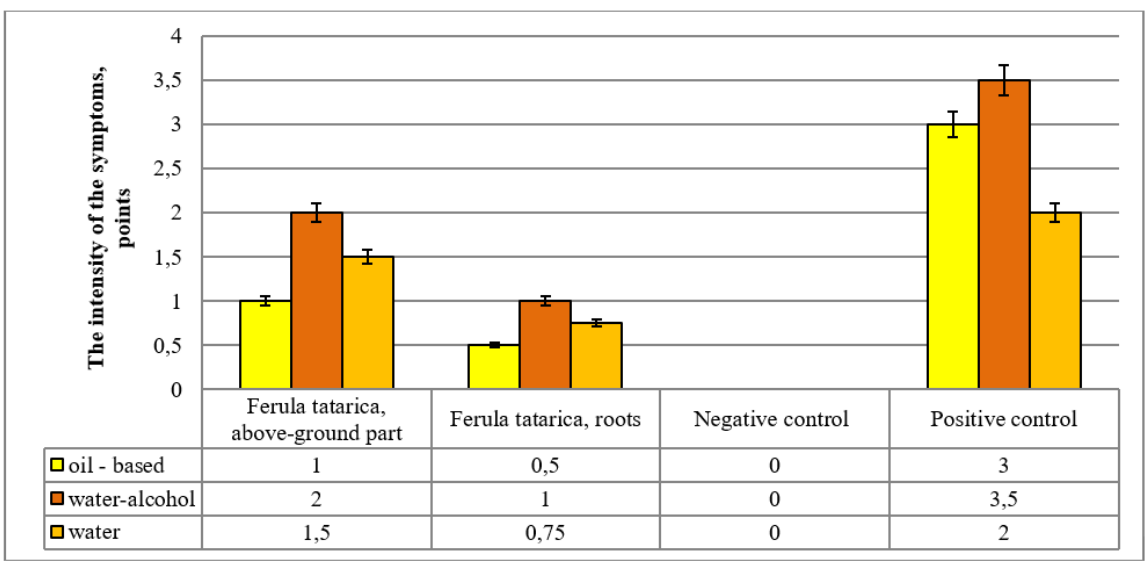


Figure 4 – Efficiency of the MBC of aqueous extracts from the aboveground and underground vegetative organs of *F. tatarica*.

sence of microorganism growth was carefully noted. Bacterial growth was assessed the following day (Figure 3).

The effectiveness of the MBC of aqueous decoctions against the selected microorganism strains was determined using the disk diffusion method (Figure 4).

As shown in Figure 4, when the extracts were tested for their effect on the growth of *E. coli* and micromycetes at minimal concentrations, the diameter of the growth inhibition zone



	Ferula tatarica, above-ground part	Ferula tatarica, roots	Negative control	Positive control
oil - based	1	0,5	0	3
water-alcohol	2	1	0	3,5
water	1,5	0,75	0	2

Figure 5 – Presence and intensity of anthelmintic properties of various extracts of *F. tatarica*.

Figure 6 – The results of the effect extracts of *F. tatarica* on the behavior and viability of worms

typically ranged from 7 to 15 mm. This indicates that bacteria, yeast, and mold fungi are sensitive to the antimicrobial and antifungal components of the extracts. Although the opportunistic pathogen *C. papapsilosis*, responsible for candidiasis, showed a high level of resistance to the aqueous decoction of *F. tatarica* when diluted 1:2, the results are still promising for the future development of antifungal drugs. The results of the study on the anthelmintic properties of *F. tatarica* extracts on *Lumbricus terrestris* annelids are presented below (Figure 5).

As shown in the diagram, all extracts affected the behavior and survival of *L. terrestris*. The strongest effect, leading to the rapid death of the annelids, was caused by the alcohol tinctures, while the least effect was observed with the oil extracts. Extracts of *F. tatarica* prepared from the aboveground parts of the plant, exhibited the most effective antiparasitic activity. The results obtained were consistent with those of the positive and negative controls.

When exposed to alcohol extracts of *F. tatarica*, the earthworms exhibited chaotic behavior, with a pronounced effect of circular movement along the side walls of the Petri dish. Under the influence of oil extracts, the earthworms became more entangled, grew inactive, and survived for more than three days. Exposure to aqueous extracts caused the worms to move randomly throughout the dish, crawl into the wells containing the extract, zigzag, and wriggle convulsively. The worms also shortened the posterior sections of their bodies and eventually subsided. Within the first day, death occurred, accompanied by hemolysis and lysis of body parts, along with the development of an unpleasant odor of decomposition. The worms' behavior was assessed based on several observed signs, outlined below (Figure 6).

At the same time, the stronger the effect, the faster the worms moved and the quicker death occurred. It should be noted that these signs were not specific to a particular type of extract. They were observed under the influence of various extracts, alternating with periods of calm, unhurried natural movement.

4 DISCUSSION

The report by Kablanova D.A. et al. (2020) provides information on the biological diversity of *Ferula* species in Kazakhstan. It shows that 51 species are found in the republic, 15 of which are endemic. Among the total number of *Ferula* species, 15 are used in folk medicine [4]. Therefore, expanding research on representatives of this genus to assess the pharmaceutical potential of endemic medicinal plants for the development of new pharmaceuticals is an urgent task.

However, there is a lack of information on the medicinal properties of *F. tatarica* or Tatar resinifer, a species native to various ecosystems of Kazakhstan. Therefore, studying the antimicrobial and antiparasitic properties of *F. tatarica* has potential for the development of domestic pharmaceuticals.

Essential oils of *Ferula* have demonstrated numerous beneficial properties in treating inflammatory and infectious diseases [27]. In Kazakhstan, extracts from *Ferula* are traditionally used to treat such conditions. Joint research by Kazakh and Russian scientists revealed that the primary bioactive components of *Ferula* essential oils include cis- and trans-isomers of fluoro-butylpropenyl disulfide, with the cis-isomer being responsible for the anti-inflammatory and immunomodulatory effects [28]. Our findings align with these studies, showing that oil and water-alcohol extracts of *F. tatarica* did not exhibit bactericidal activity against *E. coli* or fungicidal activity against *C. papapsilosis*. However, these extracts showed significant activity against the opportunistic mold fungus *A. niger*.

Interestingly, aqueous decoctions of *F. tatarica* were completely ineffective against all microorganisms tested, while aqueous infusions of both the aboveground and underground parts were active against all the microorganisms, albeit without high inhibitory capacity. These findings are consistent with reports from various authors, which highlight the antibacterial properties of *Ferula* species, including *F. tatarica* [28, 29]. It has been reported that the anti-inflammatory effect of *F. assafoetida* (commonly known as Ferula stinky) is due to its gum resin. Furthermore, the most effective medicinal properties were found in preparations made from the roots and tubers of *F. assafoetida* [30].

Previous studies on the antiparasitic properties of *F. assafoetida* have focused on its effects against *Trichomonas vaginalis* [31], *Schistosoma mansoni* [32], and *Strongylus* spp. [33]. Naturally occurring compounds in *Ferula*, such as diterpenes, phenols, and sulfur-containing substances, have been reported to exhibit antileishmanial properties [34].

Aqueous extracts of *F. foetida* resin have been tested for anthelmintic activity against *Pheretima posthuma*, showing

significant effects at a concentration of 100 mg/ml. The extract demonstrated better activity than the standard drug, *Piperazine citrate* [35]. Similarly, *F. assa-foetida* extract showed anthelmintic properties against *Fasciola hepatica* and *Dicrocoelium dendriticum*, with scanning electron microscopy revealing severe damage to the worms' sensory structures and tegument vesicles at a concentration of 200 µg/ml [36].

Our study supports these findings, demonstrating that *F. tatarica* extracts exhibit antiparasitic properties. All extracts – oil, hydroalcoholic, and aqueous – had effects on the behavior and mortality of *L. terrestris*. Alcohol tinctures produced the most significant and rapid effects, while oil extracts had the least pronounced impact.

Thus, the assessment of the pharmaceutical potential of *F. tatarica*, widely used in folk medicine, highlighted the promising prospects of the initiated developments. In the future, further investigation of the resource potential and determination of the plant's phytochemical composition are required.

CONCLUSION

1. Distribution and Phytocenosis: The distribution of *F. tatarica* in Northern Kazakhstan and the coenopopulation of the *Ferula-timothy* (*F. tatarica*, *Phleum pratense*) phytocenosis in the Akmola region are described.

2. Antimicrobial Activity: The antimicrobial activity of aqueous infusions from the underground and aboveground parts of *F. tatarica* against *E. coli*, *C. papapsilosis*, and *A. niger* is demonstrated. Additionally, oil and water-alcohol extracts of *Ferula tatarica* showed activity against the opportunistic mold fungus *A. niger*.

3. Anthelmintic Properties: The study established the anthelmintic properties of oil, water-alcohol, and water extracts of *F. tatarica*, which affected the behavior and mortality of *L. terrestris*. Alcohol tinctures caused the most significant and rapid effects, while oil extracts showed the least impact.

AUTHOR CONTRIBUTIONS

G.A.: conceptualization, study design, data validation, and writing–original draft preparation. Y.K.: collection of biological material, data curation and laboratory experiments. All authors contributed to the article and approved the submitted version.

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CONFLICT OF INTEREST

There are no conflicts of interest to declare.

OPEN ACCESS

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ОЦЕНКА БИОЛОГИЧЕСКОЙ АКТИВНОСТИ *FERULA TATARICA* FISCH. EX SPRENG. ДЛЯ ОПРЕДЕЛЕНИЯ ФАРМАЦЕВТИЧЕСКОГО ПОТЕНЦИАЛА

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АННОТАЦИЯ

В статье представлена научная информация, направленная на решение проблем установления фармацевтического потенциала *Ferula tatarica* Fisch. ex Spreng, отобранной из разнотравно-злаково-луговых фитоценозов в экосистемах Северного Казахстана. Вид широко используется в народной медицине и требует оценки его антибактериальной, противигрибковой, антигельминтной активности. Объект исследования – образцы *Ferula tatarica* в фазе цветения, экстракты растений. Методы: приготовление и анализ экстрактов согласно Государственной Фармакопее РК; анализ антимикробных и противогрибковых свойств методами серийных разведений в агаре и диско-диффузионным; анализ антигельминтных свойств растительного сырья на Lumbricus terrestris. Описано распространение Ferula tatarica Fisch. ex Spreng в регионах Северного Казахстана и ценопопуляция ферулово-тимофеевкового *(F. tatarica*, *Phleum pratense*) фитоценоза Акмолинской области. Выявлена антимикробная активность водных настоев подземной и надземной частей ферулы татарской против тестируемых микроорганизмов: *E. coli, C. papapsilosis* и *Asp. niger,* активность масляных и водно-спиртовых экстрактов Ферулы татарской против условно патогенных плесневых грибов *Asp. niger.* Установлено наличие антигельминтных свойств масляного, водно-спиртового и водного экстрактов, которые оказывали влияние на поведение и гибель *Lumbricus terrestris*. Наибольшее влияние и быструю гибель аннелид вызывали спиртовые настойки, наименьшее – масляные экстракты. *Ferula tatarica* встречается в регионе Северного Казахстана в ценопопуляция ферулово-тимофеевкового *(F. tatarica*, *Phleum pratense*) фитоценоза Акмолинской области; Водные настои подземной и надземной частей Ферулы татарской проявляют выраженную антимикробную активность против *E. coli, C. papapsilosis* и *Asp. niger;* масляные и водно-спиртовые экстракты – против *Asp. niger;* 3 Масляный, водно-спиртовой и водный экстракты обладают антигельминтными свойствами, меняют поведение и вызывают гибель *Lumbricus terrestris*. Выявленные особенности биологической активности *Ferula tatarica* показали наличие фармацевтического потенциала для дальнейших исследований вида.

Ключевые слова: *Ferula tatarica* Fisch. ex Spreng, ареал обитания, экстракты, бактерицидность; фунгицидность; антигельминтные свойства, фармацевтический потенциал.

FERULA TATARICA FISCH. EX SPRENG. ФАРМАЦЕВТИКАЛЫҚ МҮМКІНШІЛІГІН АНЫҚТАУ ҮШІН ОНЫҢ БИОЛОГИЯЛЫҚ БЕЛСЕҢДІЛІГІН БАҒАЛАУ

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АҢДАТПАСЫ

Мақалада *Ferula tatarica* Fisch. ex Spreng фармацевтикалық қасиеттерін анықтау мәселелерін шешуге бағытталған ғылыми ақпарат берілген. Бұл өсімдік түрі Солтүстік Қазақстанның экожүйелеріндегі шөпті-шалғынды фитоценоздардан жиналған нысан. Түр халық медицинасында кеңінен қолданылады және оның бактерияға, саңырауқұлаққа қарсы және антигельминттік белсенділігін бағалауды талап етеді. Зерттеу нысаны - гүлдену фазасындағы *Ferula tatarica* үлгілері, оның сығындылары. Зерттеу әдістері: Қазақстан Республикасының Мемлекеттік Фармакопеясына сәйкес сығындыларды дайындау және талдау; агарда және дискілік диффузияда сериялық сұйылту әдістерімен антимикробтық және зеңге қарсы қасиеттерін талдау; *Lumbricus terrestris* бойынша өсімдік материалдарының антигельминттік қасиеттерін талдау. *Ferula tatarica* геоботаникалық көрсеткіштері, таралуы далалық жағдайда ботаникалық әдістер арқылы сипатталған. Зерттеу аумақтар Ақмола облысының солтүстігіндегі ферула-тимофеевка (*F. tatarica, Phleum pratense*) фитоценозының ценопопуляциясы болады. *Ferula tatarica*-ның жер асты және жер үсті бөліктерінің су сығындыларының микробқа қарсы белсенділігі келесі микроағзаларға анықталды: *E. coli, C. papapsilosis* және *Asp. niger. Ferula tataricaның* оппортунистік зең саңырауқұлақтарына қарсы белсенділігі май және су-спирт сығындыларының *Asp. niger* қолданылды. Майдың, су-спирттің және су сығындыларындағы антигельминтикалық қасиеттерінің болуы зерттелді, бұл *Lumbricus terrestris* тіршілік қасиеттері мен өліміне әсер етуі тіркелді. Аннелидтердің ең көп әсері және тез өлуі спирт қоспалары, ең азы май сығындыларында байқалды. *Ferula tatarica* Fisch. ex Spreng Ақмола облысының солтүстік аумақтарында *F. tatarica, Phleum pratense* фитоценозының ценопопуляциясында кездеседі; *Ferula tatarica* жер асты және жер үсті бөліктерінің сығындысы суда ерітілгенде *E. coli, C. papapsilosis* және *Asp. niger* қарсы айқын микробқа қарсы белсенділікті көрсетті; май және су-спирт ерітінділерінде – *Asp. niger* қарсы белсенді болды; майлы, гидроспиртті және сулы сығындылардың антигельминтикалық қасиеттері байқалды, *Lumbricus terrestris* – тің физиологиялық қасиеттері өзгереді және өледі. *Ferula tatarica* биологиялық белсенділігінің анықталған ерекшеліктері түрді одан әрі зерттеу үшін фармацевтикалық әлеуеттің бар екенін көрсетті.

Түйін сөздер: *Ferula tatarica* Fisch. ex Spreng, мекендеу ортасы, сығындылар, бактерицидтік; фунгицидтік; антигельминтикалық қасиеттері, фармацевтикалық мүмкіншілігі.