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SEARCH FOR THE THERAPEUTIC POTENTIAL OF BIOLOGICALLY ACTIVE SUBSTANCES CONTAINED IN CONIFEROUS PLANTS

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Abstract

The paper presents scientific information about the problems in the search for therapeutic potential in coniferous plants widely used in folk medicine. Samples of coniferous plants growing in the mountain forests of the Western Altai in the eastern part of Kazakhstan were selected for the experiment: Baltic pine (*Pinus sylvestris* L.), European spruce (*Picea abies* L.), Siberian fir (*Abies sibírica*), Siberian pine (*Pinus sibirica* DuTour), and common juniper (*Juniperus communis* L.). During the study, the phytochemical composition of the components of *P. sylvestris L.* essential oils was determined by the indicators of sesquiterpenic fraction (69.76%), terpenoids (20.0%), and monoterpenes (5.51%). Using modern methods of studying biological activity (antimicrobial, antifungal, and anthelmintic), the authors established the presence of biological activity in the extracts of selected coniferous plants. In all coniferous plants, bactericidal activity was manifested in water decoctions, where biological preparations of Siberian fir and Baltic pine were more active. The oil extracts showed less bactericidal activity. Among them, extracts of Siberian pine and juniper were inactive, and the extract of European spruce was more active in its native form and 1:2 dilution. Among plants with a complete absence of bactericidal activity against the *Candida parapsilosis* opportunistic yeast, Siberian fir should be named. In other coniferous plants (European spruce, Baltic pine, juniper), bactericidal activity was detected only in oil solutions in a dilution of 1:2, and oil extract of Siberian pine in a dilution of 1:8 had a suppressive effect. Water/alcohol tincture of Siberian fir was found to have high fungicidal activity against *Aspergillusniger*, which continued to influence the growth of the micromycete at a dilution of 1:64 during the observation period. The presence of antiparasitic properties was observed in some plant extracts of coniferous forest plants. The best results were noted in alcohol tinctures of Baltic pine, juniper, and Siberian pine.

Key words: coniferous plants; biologically active substances; phytochemical composition; antimicrobial properties; antiparasitic effect; bactericidal activity; therapeutic potential.

Basic position and Introduction

Medicinal plants have long been used as a source of traditional medicinal remedies in almost all known civilizations [1]. Nature provides a significant supply of new phytochemicals, which are called natural products, and the development of medicines from them is a difficult task for attracting new potential customers [2].

Phytochemicals are substances produced mainly by plants that have different biological effects. In the pharmaceutical industry, plants are the main source of various active ingredients. They exhibit pharmacological effects that can be used for the treatment of bacterial and fungal infections, as well as chronic degenerative diseases such as diabetes and cancer [3].

The traditional and pharmaceutical use of extracts of various coniferous trees against diabetes, neurological disorders, inflammation, and cancer has been described. Phytochemical components present in coniferous tree extracts are non-toxic at the therapeutic level, and polyphenolic compounds have significant biological activity. Stilbens, terpenes, alkaloids, lignins, and flavonoids, such as quercetin, rutin, resveratrol, pyrolytic carbon (PYC) compounds, and enzogenol, have sedative, antidiabetic, antitumor and anesthetic effects. In addition, phytochemicals present in coniferous tree extracts help regulate glucose and lipid metabolism, insulin secretion by stimulating β-cells, the NF-kB signaling pathway, inhibition of gluconeogenic enzymes, the protective effect of reactive oxygen species (ROS), as well as targeting and modulating cytokines that affect neuronal cells and reduce oxidative stress [4].

Aqueous extracts obtained from plant shoots collected in 2019 at the arboretum in Zelenka (Poland), including individual samples of *Picea abies* L., *Larix deciduas* Mill, *Pinus sylvestris* L., *Pseudotsuga menziesii*, and *Juniperus communis* L., are a rich source of phenols such as caffeic acid, ferulic acid, chlorogenic acid, 4-hydroxybenzoic acid, and many others. The obtained extracts showed antioxidant and antimicrobial properties *in vitro* [5].

Thus, the phytochemicals of coniferous trees with a biologically active effect can be used as an alternative to synthetic medicines. They can be reliably used in the future since they can be useful in the development of new therapeutic agents for the treatment of relevant pathologies [4].

In Kazakhstan, coniferous forests grow in the mountains of the Kazakh part of Altai, the Dzungarian Alatau, the eastern spurs of the Tien Shan, and the plains of the forest-steppe zone of Northern Kazakhstan [6, 7]. Residents of forested areas widely use the vegetative organs of woody plants (especially pine trees) for therapeutic and preventive purposes and therefore, the study of their biological effects is relevant.

The study aimed to evaluate the phytochemical composition of coniferous trees and study their antimicrobial properties and antiparasitic effects to establish their therapeutic potential.

Materials and methods

The object was the shoots of the following coniferous plants growing in the mountain forests of the Western Altai in the eastern part of Kazakhstan: Baltic pine (*P. sylvestris* L.), European spruce (*P. abies* L.), Siberian fir (*Abies sibírica*), Siberian pine (*Pinus sibirica* DuTour), juniper (*J. communis* L.). Branches of plants with healthy needles were selected.

The sampling of coniferous plants was carried out in the herbaceous pine forest (hP) located on the territory of the Ridder forestry, the Central Forestry (block 26, plot 17), the grass and fern fir forest (gfF) on the territory of the Fir part of the Butakovsky forestry (block 38 block, plot 40) and small clumps of Siberian pine were found locally in the areas of fir and aspen forests. The juniper samples were taken on the territory of the Ivanovo ridge, near the city of Ridder.

Pine needles were selected for analysis of the phytochemical composition of coniferous plants, given that in folk medicine, various pine organs are in great demand. Samples of all conifers for laboratory experiments were taken at a height of 1.7-1.8 m at the level of the respiratory organs of an adult tree from four sides (north, south, east, and west). The selected samples of plant needles were mixed to obtain an average sample and dried at room temperature for one week. To isolate the essential oil, the method of steam distillation (hydrodistillation method) was used. Chromato-mass spectrometric method was used to determine the component composition of essential oils. The analysis of pine needles essential oil was carried out on an Agilent 7890A gas chromatograph with an Agilent 5975C mass-selective detector in the laboratory of the Physico-chemical research methods engineering profile of the Chemical Faculty at the E.A.Buketov Karaganda State University [8].

Experimental studies on the analysis of the biological (antimicrobial, antifungal, antihelminthic) activity of extracts were carried out in the Agricultural Biotechnology Research Platform (NIP CKhB) of the S. Seifullin Kazakh Agrotechnical University (KATU) in 2020-2022.

The assessment of the biological activity of coniferous plant extracts was evaluated sequentially in several stages. Oil and water infusions, alcohol tinctures, and water decoctions were prepared from the biomass of coniferous plants at a rate of 1:10. Infusions and tinctures were infused for 2 weeks in a dark place, and decoctions were prepared immediately before use. Sterilization filtration of the preparations was carried out using filters with a pore diameter of 0.45 nm.

The extracts were stored at a temperature of 4-6°C for no more than 24 hours [9].

The analysis of the antimicrobial and antifungal activity of plant raw materials was carried out by the method of serial dilutions in agar and disk diffusion method. Determination of minimum suppressive concentrations (MSC) and minimum bactericidal concentrations (MBC) of aqueous plant extracts was carried out by sequential micro-dilutions in Mueller-Hinton broth [10-14].

To determine the bactericidal MSC, the extracts were tested against *Escherichia coli*, and for the antifungal MSC, the extracts were tested against opportunistic strains, opportunistic mycosis pathogens, *Candida parapsilosis* yeast strain 398.2 and *Aspergillus niger* mold.

Antihelminthic properties were tested on annelids (*Lumbricus terrestris* ringworms), which were used as a test object.

The MSC was determined visually by the absence of visible growth of microorganisms. Standard data were used to interpret the results of determining the sensitivity of microorganisms to antimicrobial agents [15].

To establish the presence of a helminthicidal effect, a proprietary method of accounting for the results was developed. Attention was paid to the naturalness of the behavior of worms, the desire to approach the wells or move away from them, the death of worms within a certain period, the presence and intensity of the smell of decomposition in case of death, and the presence and intensity of hemolysis. For the presence of each of the signs and its intensity, crosses were placed according to the principle: +++: a very pronounced sign, ++: a pronounced sign, +: a weakly pronounced sign. In the absence of results, it was marked with a minus. Then the total number of "+" was calculated and points were put down [7].

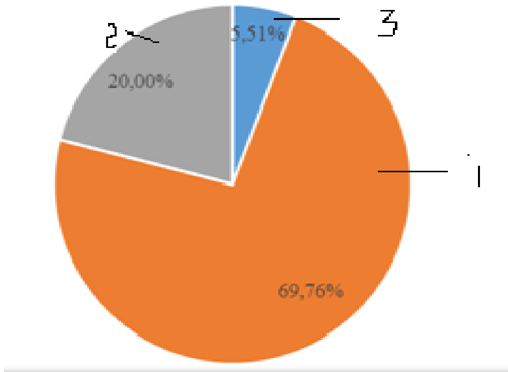
Results

Table 1 shows the indicators of the organoleptic properties of the essential oils obtained from Baltic pine needles. Figure 1 shows the composition of essential oils obtained from the same plant.

Table 1 – Indicators of organoleptic properties of Baltic pine needle essential oils

No.	Indicators	Characteristics
1	Color	light yellow color
2	Smell	pleasant pine odor
3	Physical condition	oily consistency
4	Weight of essential oil/100 g of needles	0.31± 0.04

The distribution of essential oil components in the examined samples is shown in the diagram. The average values of the established indicators of the essential oil components showed a high content of sesquiterpenic fraction (69.76%), an average content of terpenoids (20.0%), and a low content of monoterpenes (5.51% of the total content of the identified compounds). The total content (%) of the identified components of the essential oil of the Baltic pine was 95.27%.



1 – sesquiterpenic; 2 – terpenoids; 3 – monoterpenes

Figure 1- The composition of essential oils obtained from the sample *P. sylvestris* L.

To detect the bactericidal MSC, the extracts were tested against *E. coli*, and for the antifungal MSC, they were tested against opportunistic strains, pathogens of opportunistic mycoses, *C. parapsilosis* yeast strain 398.2 and *A. niger* mold fungi. MSC accounting was performed visually by the absence of visible growth of microorganisms (Tables 2-4).

Table 2 – Bactericidal MSC of coniferous plant extracts against *E. coli* (degree of dilution)

Type of raw materials	Oil extracts	Water-alcohol extracts	Water extracts	Water decoctions
Pinus sibirica DuTour	-	-	-	1:32
Picea abies L.	1:2	-	1:64	1:64
Pinus sylvestris L.	1:32	-	-	1:128
Ábies sibírica	1:512	-	-	1:256
Juniperus communis	-	1:128	1:32	1:2
Control	-	-	-	-

As can be seen from Table 2, several extracts of coniferous plants have no bactericidal or bacteriostatic activity at all, and most of them exhibit weakly expressed activity against *E. coli*. In all coniferous plants, bactericidal activity was manifested in water decoctions, with the biological preparations of Siberian fir and Baltic pine demonstrating more activity.

The oil extracts showed less bactericidal activity. Among them, extracts of Siberian pine and juniper were inactive, and the extract of European spruce was more active in its native form and 1:2 dilution.

Unexpectedly, water/alcohol tinctures of coniferous plants turned out to be inactive. Bactericidal activity was detected only in the juniper water/alcohol extract (Figure 2).

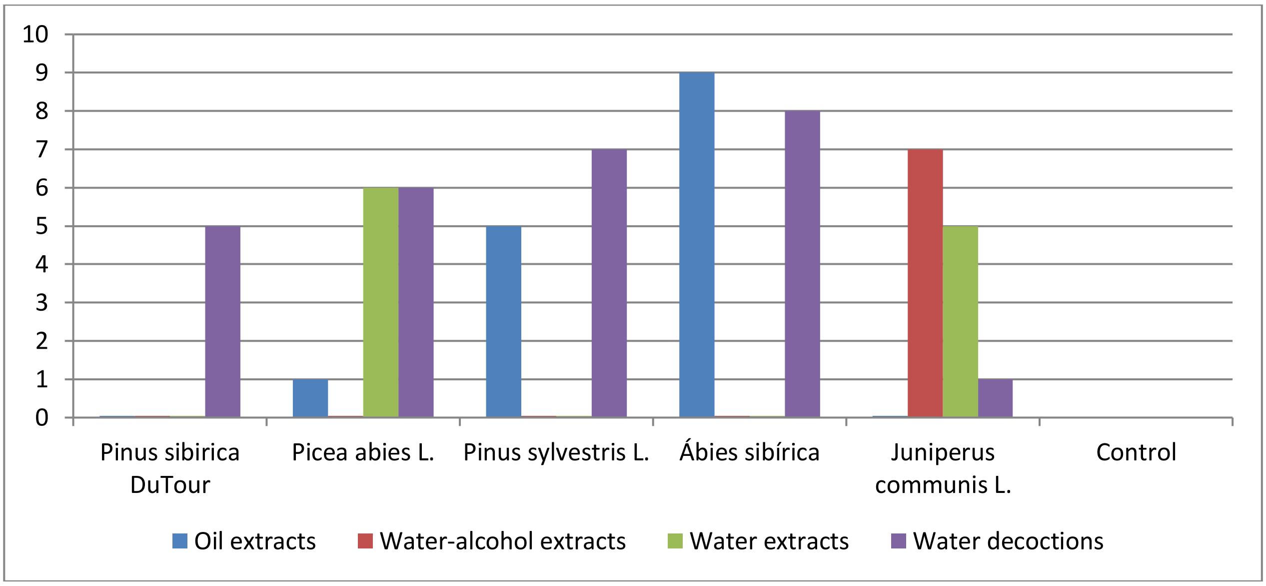


Figure 2 – MSC of coniferous plant extracts against *E. coli* bacteria (logarithm of dilution)

Table 3 – MSC of coniferous plant extracts against *C.parapsilosis* opportunistic yeast

Type of raw materials	Oil extracts	Water-alcohol extracts	Water extracts	Water decoctions
Pinus sibirica DuTour	1:8	-	-	-
Picea abies L.	1:2	-	-	-
Pinus sylvestris L.	1:2	-	-	-
Ábies sibírica	-	-	-	-
Juniperus communis L.	1:2	-	-	-
Control	-	-	-	-

As can be seen from Table 3, the absence of fungicidal or fungistatic activity against opportunistic yeast is recorded in a large number of plant extracts, except for oil extracts. Water decoctions and infusions, as well as tinctures of all analyzed coniferous plants, were inactive against *C.parapsilosis*.

Among plants with a complete absence of bactericidal activity against the *C. parapsilosis* opportunistic yeast, Siberian fir should be named. In other coniferous plants (European spruce, Baltic pine, and juniper), bactericidal activity was detected only in oil solutions in a 1:2 dilution. Only the oil extract of Siberian pine in a dilution of 1:8 had a suppressive effect (Figure 3).

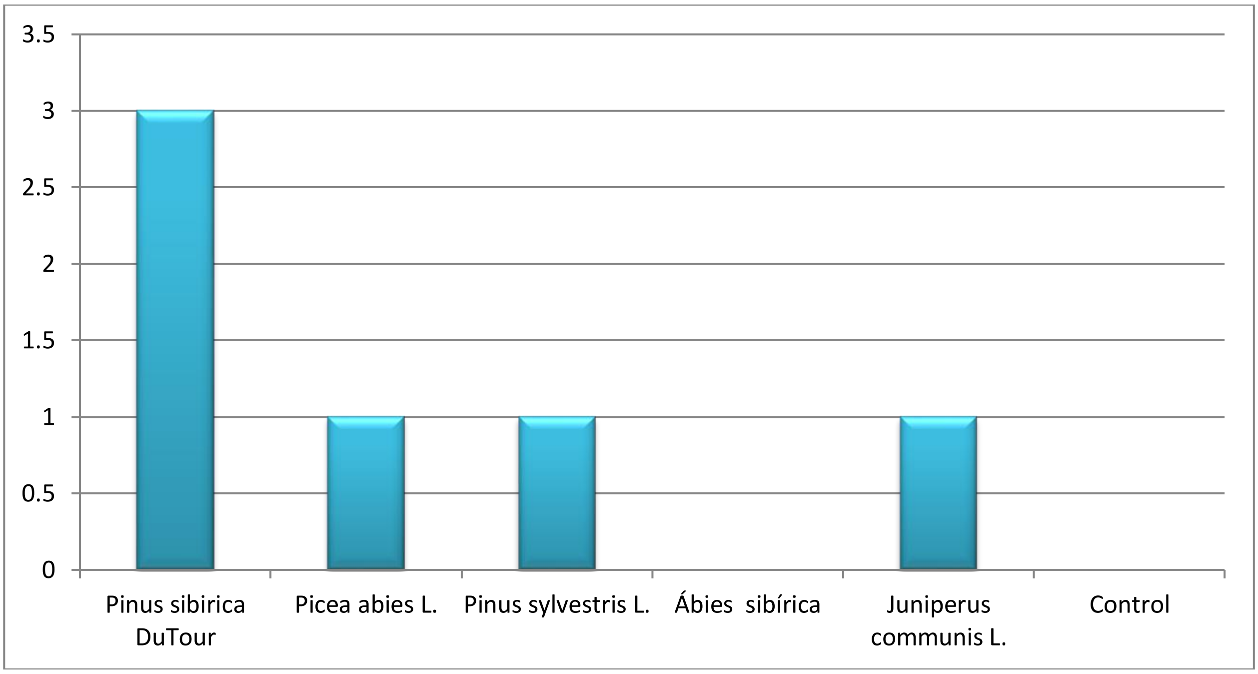


Figure 3 – MSC of oil extracts of coniferous plants against *C. parapsilosis* opportunistic yeast (logarithm of dilution)

Table 4 – MSC of coniferous plant extracts against the causative agent of opportunistic mold mycoses *A.niger*

Type of raw materials	Oil extracts	Water-alcohol extracts	Water extracts	Water decoctions
Pinus sibirica DuTour	1:4 (f/s)	-	-	1:128 (f/s)
Picea abies L.	-	-	-	-
Pinus sylvestris L.	1:4 (f/s)	-	-	-
Ábies sibírica	-	1:64 (f/c)	-	-
Juniperus communis L.	-	-	-	-
Control	-	-	-	-

Note: f/c is fungicidal, f/s is fungistatic

As can be seen from Table 4, a greater number of extracts of coniferous plants are characterized by the absence of fungicidal or fungistatic activity against the *A. niger* opportunistic mold fungi. Among the studied wild coniferous plants of the forest, the complete absence of fungicidal activity against opportunistic molds was recorded in two plants: European spruce and common juniper. For two oil extracts, the presence of fungistatic properties was observed only in native extracts (Siberian dwarf pine and Baltic pine). Aqueous extracts of all conifers did not inhibit the growth of micromycetes. Unexpectedly, the growth of *A. niger* was actively suppressed on the first day by an aqueous decoction of Siberian pine in dilution up to 1:128. This indicates a high level of suppression of mycelium growth by this decoction and the suppression of spore formation by the corresponding phytoncides.

The only preparation with high fungicidal activity against *A.niger* was a water/alcohol tincture of Siberian fir, which continued to influence the growth of the micromycete at a dilution of 1:64 during the observation period.

The disk diffusion method determined the MBC of biological preparations with the presence of antimicrobial or antifungal activity against three strains of microorganisms selected by us (Table 5).

Table 5 – MBC and minimal fungicidal concentrations of wild coniferous plant water decoctions

№	Name of vegetable raw materials	Diameter of the growth retardation zone, mm (medium / min/max)		
		E. coli	*C. papapsilosis*	*Asp. niger*
8	*Pinus sibirica* DuTour	12,0 11,0-13,0	-	8,0 7,0-9,0
11	*Picea abies* L.	8,5 8,0-9,0	10,0 9,0-11,0	-
13	*Pinus sylvestris* L.	10,5 10,0-11,0	-	13,0 11-15
14	*Ábies sibírica*	10,0 9,0-11,0	-	30,0 28,0-32,0
28	*Juniperus communis*	7,0 6,0-8,0	-	-
	Control	-	-	-

As can be seen from Table 5, when MBC is exposed to the growth of *E. coli* and micromycetes, the diameter of the growth delay zone of microorganisms in most cases has limits from 7 to 15 mm, which indicates a weak sensitivity of microorganisms to antimicrobial and antifungal components of coniferous plant extracts. The obtained results allow us to state the presence of bacteriostatic properties in the aqueous extracts of wild coniferous plants included in the study. Such a general conclusion can be drawn from all the studied water decoctions, i.e. almost all of them have bacteriostatic properties against *E. coli*. Analysis of water decoctions of coniferous plants against opportunistic yeast *C. parapsilosis* showed the presence of a fungistatic effect only in the decoction of spruce. The remaining water decoctions not only did not have a fungicidal effect but also contributed to the active growth of yeast around the discs.

The detection of fungicidal properties of aquatic decoctions of coniferous forest plants against opportunistic mold fungi *A. niger* showed that the micromycete was quite sensitive to several decoctions (Baltic pine, Siberian pine) (the diameter of the lysis zone ranging from 8 to 15 mm), and in the presence of decoction of Siberian fir, the growth of *A. niger* almost completely stopped (Figure 4).

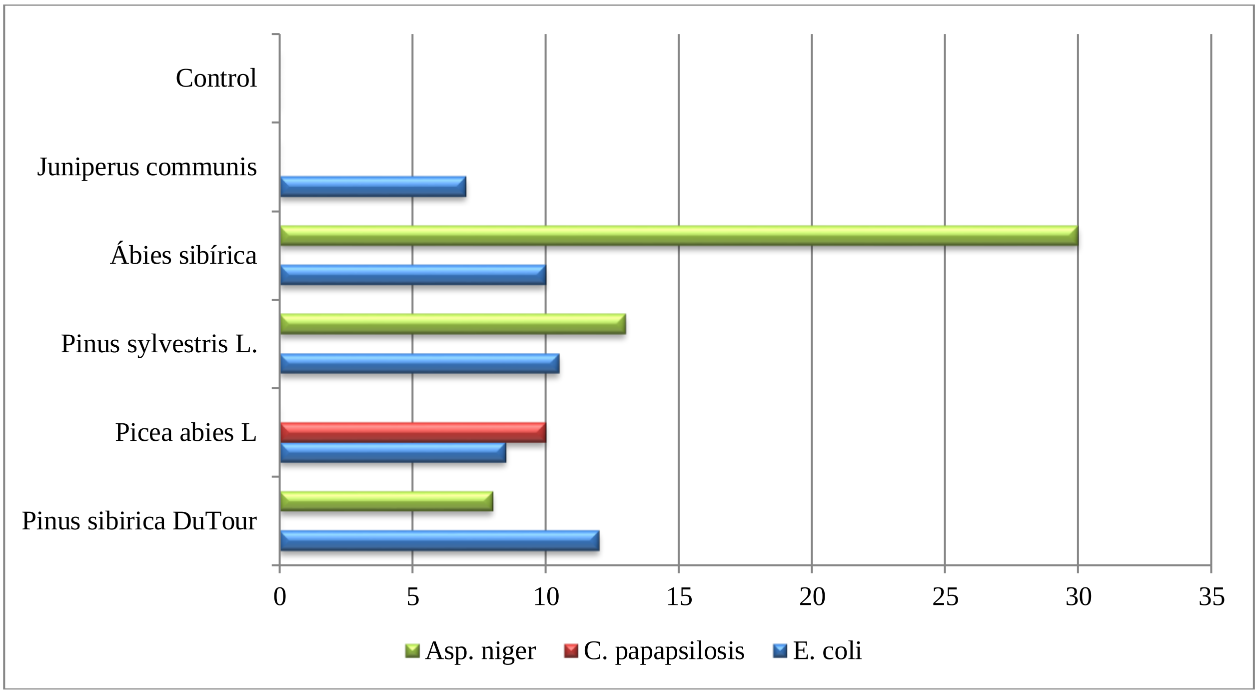


Figure 4 – The sensitivity of microflora to water decoctions of coniferous plants

As can be seen from Figure 3, only extracts from European spruce showed fungistatic activity against *the C. parapsilosis opportunistic yeast.* Water extracts of Siberian fir have pronounced fungicidal activity against the *A. niger* opportunistic mold fungi. Concerning the *E. coli* strain, all aqueous extracts showed a noticeable fungistatic effect.

The results obtained indicate the presence of various biological effects, in particular, antimicrobial and fungicidal activity, in coniferous plant extracts, which makes it possible to conclude that they can be used for the manufacture of preparations with a therapeutic effect against pathogens of infectious diseases. The study of antiparasitic activity by a modified technique involved the use of a test culture of earthworms. To determine the presence of a helminthicidal effect, helminths were transferred from Petri dishes to ready-made nutrient media with wells pre-filled with extracts. The behavior of worms on a solid nutrient medium was monitored every 3-6-12 hours for 3 days (Figure 5).

Figure 5 – The process of observing the behavior of worms in the study of antiparasitic properties of coniferous forest plant extracts

The results of the study of antiparasitic properties in plant extracts of coniferous plants in conditional scores are presented in Table 6.

Table 6 – Summary data on the presence of antihelminthic properties inwild forest plant extracts

№	Name of vegetable raw materials	Presence and intensity of antiparasitic properties (score)		
		oil	water-alcohol	water
1	*Pinus sibirica* DuTour	0,5	6,0	1,5
2	*Picea abies* L.	3,0	5,0	2,5
3	*Pinus sylvestris* L.	3,0	7,0	0
4	*Ábies sibírica*	4,0	4,0	0
5	*Juniperus communis* L.	0	7,0	5,0
	Control	0	1,0	0

As can be seen from the data obtained on the analysis of antiparasitic properties of coniferous forest plant extracts, the best results are obtained from alcohol tinctures of Baltic pine, juniper, and Siberian pine. Among the aqueous solutions, we noted some effects on the worms in juniper extracts and weaker effects from European spruce and Siberian pine. Among the oil extracts, extracts of Siberian fir can be distinguished. The following preparations did not affect the behavior of *L.terrestris*: aqueous extracts of Baltic pine and Siberian fir and oil extract of juniper.

Discussion

The resources of woody plants are divided into trunks (wood), branches, woody greens, and cones, where the needles are the most important part of medicinal purposes due to the accumulation of essential oils in them. Essential oils are a complex mixture of hydrocarbons and their derivatives that exhibit significant biological efficiency [16, 17]. For each region, information about the species diversity of resource plant species for the development of various industries is important. The resource potential of medicinal plants is the basis for the functioning of the pharmaceutical industry. Essential oil species play an essential role in the production of many medicines because they have long been known as antispasmodic, diuretic, cholelitic, stimulating, and hepatoprotective medications [18, 19]. Thus, for example, the main phenolic components of *J. communis*extract are rutin, apigenin, isoscutellarein, hypolaetin, and protocatechuic acid. During an experiment on cancer cells of various origins, it was noted that *J. communis* extract consisting of a unique combination of phenolic compounds affected cancer cells using specific mechanisms of apoptosis [20].

According to experts, the collection of the Main Botanical Garden of the Institute of Botany and Phyto-introduction in Kazakhstan includes 1,115 taxa of medicinal plants of the world flora (1,071 species, 412 genera, 93 families). Among them, representatives of foreign flora equal 621 taxa (55.7%), Kazakh plants are represented by 452 taxa, and introduced flora (having a secondary area on the territory of Kazakhstan) is represented by 43 taxa. The vast majority of taxa in the collection are represented by annual or perennial grasses (annuals: 173 taxa, biennials: 55, herbaceous perennials: 712, herbaceous lianas: 20: total: 960 taxa). Hardy shrub forms account for less than 14% (155 taxa): semi-shrubs and small shrubsfor 57, woody lianas for6, shrubs for 75, and trees for 17 taxa [21].

The types of coniferous plants we selected are widespread in Kazakhstan and some of them are widely used among the population for therapeutic and preventive purposes in the form of water-based, alcohol-based, oil-based tinctures, decoctions, resins, balms, gels, etc. A potential candidate for these purposes is a coniferous tree extract (CTE) with an antibacterial effect [22]. According to our data, the essential oils of the Baltic pine contain the entire spectrum of important phytochemical components, including monoterpenes, terpenoids, and sesquiterpenes.

The analysis of the biological activity of phytochemical components of coniferous plants taken in the study showed that several preparations had an antimicrobial effect, others had antifungal properties, and some either did not show antagonistic properties at all or exhibited a stimulating effect and improved the growth of microorganisms.

Thus, we identified the bactericidal activity of water decoctions obtained from all coniferous plants. Moreover, the highest antimicrobial activity against *E. coli* was registered in water decoctions of Siberian fir and Baltic pine, and its absence was noted in oil extracts. Among the water/alcohol extracts, bactericidal activity was detected only in the juniper preparation. The MSC of juniper water/alcohol extract against the *E. coli* bacterium was manifested in a dilution of 1:128.

The absence of fungicidal or fungistatic activity against opportunistic yeast was recorded in water decoctions and infusions, as well as in water/alcohol extracts of all analyzed coniferous plants. Only oil extracts of plants that had a short-term fungistatic effect were active against *C.parapsilosis*. Our results are consistent with the data of other authors who claimed high resistance of *C. parapsilosis* yeast against fungicidal preparations [23, 24]. Among the plants with a complete absence of bactericidal activity against*C. parapsilosis* opportunistic yeast,Siberian fir should be named.

When studying the MSC of CPE against *A.niger* opportunistic mold fungi, it was found that none of the water and oil extracts showed fungistatic and fungicidal properties.

The analysis of antiparasitic properties in coniferous forest plant extracts showed the presence of the influence of the preparations on the behavior and vital activity of *L.terrestris.* The best results were obtained from the alcohol tinctures of Baltic pine, juniper, and Siberian pine; aqueous solutions of extracts of juniper, European spruce, and Siberian pine; and oil extracts of Siberian fir.

Conclusion

The results obtained indicate the presence of various biological effects in coniferous plant extracts, in particular, antimicrobial and fungicidal properties, which allows us to conclude that they can be used for the manufacture of preparations with a therapeutic effect against pathogens of infectious diseases.

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Түйін

Мақалада дәстүрлі медицинада кеңінен қолданылатын қылқан жапырақты өсімдіктердің емдік әлеуетін іздеудегі проблемалар туралы ғылыми ақпарат берілген. Эксперимент үшін Қазақстанның шығыс аумағындағы Батыс Алтайдың таулы ормандарында өсетін қылқан жапырақты өсімдіктердің үлгілері таңдалды: қарағай (*Pinus sylvestris* L.), кәдімгі шырша (*Picea abies* L.), сібір шыршасы (*Ábies sibírica*), сібір балқарағайы (*Pinus sibirica* DuTour), кәдімгі арша (*Juniperus communis* L.). Зерттеу барысында *Pinus sylvestris* L. эфир майларының компоненттерінің фитохимиялық құрамы сесквитерпендік фракция (69,76%), терпеноидтар (20,0%), монотерпендер (5,51%) бойынша анықталды. Биологиялық белсенділікті (микробқа қарсы, саңырауқұлаққа қарсы, антигельминтикалық) зерттеудің заманауи әдістерін қолдана отырып, біз таңдаған қылқан жапырақты өсімдіктердің сығындыларының биологиялық белсенділігінің болуын зерттедік. Барлық

қылқан жапырақты өсімдіктерде бактерицидтік белсенділік сібір шыршасы мен қарағайдың биологиялық заттары белсендірек болған су қайнатпаларында көрінді. Май сығындылары бактерицидтік белсенділікті әлсіз деңгейінде көрсетті. Олардың ішінде сібір балқарағайы мен кәдімгі арша сығындылары белсенді емес, ал кәдімгі шырша сығындысы өзінің табиғи түрінде белсендірек болды және 1:2 сұйылтылған. Шартты-патогенді ашытқы *Candida papapsilosiske* қарсы бактерицидтік белсенділігі мүлдем жоқ өсімдіктердің арасында сібір шыршасын атап өткен жөн. Басқа қылқан жапырақты өсімдіктерде (шырша, қарағай, арша) бактерицидтік белсенділік тек 1:2 сұйылтудағы май ерітінділерінде анықталды, 1:8 сұйылтудағы сібір балқарағайының май сығындысы басым әсер етті. Сібір шыршасының су-спирт тұнбасы *А.нигерге* қарсы жоғары фунгицидтік белсенділікке ие болып шықты, ол бақылау кезеңінде 1:64 сұйылту кезінде микромицеттердің өсуіне әсер етуді жалғастырды. Қылқан жапырақты орман өсімдіктерінің кейбір өсімдік сығындыларында паразитке қарсы қасиеттердің болуы анықталды. Ең жақсы нәтиже кәдімгі қарағайдың, кәдімгі аршаның және сібір балқарағайының алкоголь тұнбаларында табылды.

Кілт сөздер: қылқан жапырақты өсімдіктер; биологиялық белсенді заттар; фитохимиялық құрамы; микробқа қарсы қасиеттері; антипаразиттік әсер; бактерицидтік белсенділік; емдік потенциал.

Аннотация

В статье представлена научная информация о проблемах при поиске терапевтического потенциала среди хвойных растений, широко используемых в народной медицине. Для эксперимента отобраны пробы хвойных растений, произрастающих в горных лесах Западного Алтая в восточной части Казахстана: сосны обыкновенной (*Pinus sylvestris* L.), ели обыкновенной (*Picea abies* L.), пихты сибирской (*Ábies sibírica*), кедра сибирского (*Pinus sibirica* DuTour), можжевельника сибирского. В ходе исследований был определен фитохимический состав компонентов эфирных масел *Pinus sylvestris* L. по показателям сесквитерпеновой фракции (69,76%), терпеноидов (20,0%), монотерпенов (5,51%). Используя современные методы изучения биологической активности (антимикробной, противогрибковой, антигельминтной), нами установлено наличие биологической активности экстрактов отобранных хвойных растений. У всех хвойных растений бактерицидная активность проявлялась у водных отваров, где более активными были биопрепараты пихты сибирской и сосны обыкновенной. Масляные экстракты проявили бактерицидную активность слабее. Среди них не активными были экстракты кедра сибирского и можжевельника обыкновенного, а экстракт ели обыкновенной был активнее в нативном виде и разведении 1:2. Среди растений с полным отсутствием бактерицидной активности против условно-патогенных дрожжей *Candida papapsilosis* следует назвать пихту сибирскую. У остальных хвойных растений (ель, сосна, можжевельник) бактерицидная активность выявлена только у масляных растворов в разведении 1:2, масляный экстракт кедра сибирского в разведении

1:8 оказывал подавляющий эффект. С высокой фунгицидной активностью в отношении *A.niger* оказалась водно-спиртовая настойка пихты сибирской, которая продолжала оказывать влияние на рост микромицета в разведении 1:64 в течение периода наблюдения. Наличие антипаразитарных свойств выявлено у некоторых растительных экстрактов хвойных растений леса. Лучшими результатами отличались спиртовые настойки сосны обыкновенной, можжевельника обыкновенного и кедра сибирского.

Ключевые слова: хвойные растения; биологически активные вещества; фитохимический состав; антимикробные свойства; антипаразитарный эффект; бактерицидная активность; терапевтический потенциал.