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Antimicrobial activity of aqueous-alcoholic extracts from myrtle leaves in relation to strains isolated from patients with cystic fibrosis

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The search for new antimicrobial medicines based on medicinal plant raw materials (MPRM) and its effective and safe use in modern pharmaceutical practice remains one of the most pressing issues in pharmacy. Today, the search for new biologically active compounds (BACs) with antimicrobial and antifungal activity is ongoing. Due to the content of the BACs complex, preparations based on MPRMs have a milder effect on the human body compared to synthetic analogues. According to the results of studying some foreign studies and publications on the topic of antimicrobial and antifungal activity, a promising source of BACs, namely the leaves of common myrtle (*Myrtus communis* L.), is of scientific interest.

The aim. Analysis and comparative study of the antibacterial activity of samples of extracts obtained using ethanol of various concentrations, and an infusion of common myrtle leaves (*Myrtus communis* L.) against clinical strains isolated from patients with cystic fibrosis.

Materials and methods. The objects of the study were water-alcohol extracts from common myrtle leaves, comparison preparations — ethanol with a concentration of 40, 70, 96% and eucalyptus tincture. 5 strains of pathogenic microorganisms isolated from the sputum of patients with cystic fibrosis were used as test cultures. The minimum inhibitory concentration was assessed using the method of double serial dilutions in broth.

Results. All water-alcohol extracts from common myrtle leaves showed antimicrobial activity exceeding the control samples against 3 mucoid strains — *Burkholderia cenocepacia*, *Stenotrophomonas maltophilia* and *Pseudomonas aeruginosa*. No antimicrobial activity was detected for the remaining 2 strains. A pronounced antimicrobial effect was possessed by 70% tincture and aqueous infusion of leaves.

Conclusion. The data obtained during the study allow us to draw conclusions about the further prospects of studying 70% myrtle tincture and aqueous infusion for use in the therapy of patients with cystic fibrosis.

Keywords: common myrtle; *Myrtus communis* L.; leaves; cystic fibrosis; antimicrobial activity; tincture; infusion

Abbreviations: ABDs — antibacterial drugs; BACs — biologically active compounds; SPh RF — State Pharmacopoeia of the Russian Federation; MPRM — medicinal plant raw material; MBC — minimum bactericidal concentration; MIC — minimum inhibitory concentration.

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Антимикробная активность водно-спиртовых извлечений из листьев мирта обыкновенного в отношении штаммов, выделенных от пациентов с муковисцидозом

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Поиск новых антимикробных препаратов на основе лекарственного растительного сырья (ЛРС) и его эффективное и безопасное использование в современной фармацевтической практике остается по-прежнему одним из актуальных вопросов фармации. На сегодняшний день постоянно ведётся поиск новых биологически активных соединений (БАС) с антимикробной и противогрибковой активностью. Благодаря содержанию комплекса БАС препараты на основе ЛРС оказывают более мягкое действие на организм человека по сравнению с синтетическими аналогами. По результатам изучения некоторых зарубежных исследований и публикаций на тему антимикробной и противогрибковой активности, научный интерес представляет перспективный источник получения БАС, а именно листья мирта обыкновенного *(Myrtus communis* L.).

Цель. Анализ и сравнительное изучение антибактериальной активности образцов извлечений, полученных с помощью спирта этилового различной концентрации, и настоя из листьев мирта обыкновенного (*Myrtus communis* L.) в отношении клинических штаммов, выделенных от пациентов с муковисцидозом.

Материалы и методы. Объектами исследования были водно-спиртовые извлечения из листьев мирта обыкновенного, препараты сравнения — спирт этиловый с концентрацией 40, 70, 96% и настойка эвкалипта. В качестве тестовых культур использовали 5 штаммов патогенных микроорганизмов, выделенных из мокроты пациентов с муковисцидозом. Минимальную ингибирующую концентрацию оценивали с помощью метода двойных серийных разведений в бульоне.

Результаты. Все водно-спиртовые извлечения из листьев мирта обыкновенного проявляли антимикробную активность, превосходящую контрольные образцы в отношении 3 мукоидных штаммов — *Burkholderia cenocepacia*, *Stenotrophomonas maltophilia* и *Pseudomonas aeruginosa*. По оставшимся 2 штаммам антимикробная активность не выявлена. Выраженным антимикробным эффектом обладала настойка мирта 70% и водный настой листьев.

Заключение. Полученные в ходе проведённого исследования данные позволяют сделать выводы о дальнейших перспективах изучения настойки мирта 70% и водного настоя листьев мирта для использования в терапии пациентов, больных муковисцидозом.

Ключевые слова: мирт обыкновенный; *Myrtus communis* L.; листья; муковисцидоз; антимикробная активность; настойка; настой

Список сокращений: АБЛП — антибактериальные лекарственные препараты; БАС — биологически активные соединения; ГФ РФ — Государственная фармакопея Российской Федерации; ЛРС — лекарственное растительное сырьё; МБК — минимальная бактерицидная концентрация; МИК — минимальная ингибирующая концентрация

INTRODUCTION

Patients with cystic fibrosis occupy a special place in the category of patients who need antimicrobial therapy on an ongoing basis. Most bacterial strains isolated from patients with cystic fibrosis are characterised by pronounced antibiotic resistance, both genetically mediated and acquired. At the same time, more than 85% of the strains are resistant to one or more antibacterial drugs (ABDs) [1]. Thus, science is faces the task of improving existing antimicrobial drugs and searching for new potential molecules and biologically active compounds (BACs), including to improve the effectiveness of cystic fibrosis therapy and the quality of life of patients with this diagnosis.

According to the international register of the Cystic Fibrosis Foundation[1] (Washington, USA), it has been established that patients with cystic fibrosis are predominantly dominated by microbial flora such as Pseudomonas aeruginosa and Staphylococcus aureus, to a lesser extent — *Haemophilus influenzae*, *Stenotrophomonas maltophilia*, *Achromobacter xylosoxidans* and *Burkholderia cenocepacia* [2, 3]. The main difficulty in the treatment of cystic fibrosis is represented by patients infected with *Burkholderia cenocepacia* strains, which are resistant to most of the ABDs used in modern therapy [4, 5]. In this regard, a search is currently underway for new BACs with antimicrobial and antifungal activity. Due to the content of the BACs complex, drugs based on MPRM have a milder effect on the human body and do not cause addictive syndrome compared to synthetic analogues [6]. It is known that BACs such as flavonoids play a leading role in the formation of the most important pharmacotherapeutic effects of medicinal plants, including antimicrobial, anti-inflammatory, antifungal, antiviral, choleretic, antispasmodic, etc. [7].

Based to the results of studying some domestic and foreign studies and publications on the aim of antimicrobial and antifungal activity of MPRM, such a promising source of BACs as common myrtle (*Myrtus communis* L.) is of scientific interest [8–10]. Due to the presence of flavonoids in the raw materials of myrtle (*Myrtus communis* L.), leaves and fruits, as well as essential oil from this plant, have long been used in many countries as an antimicrobial, antifungal and anti-inflammatory agent [11].

Common myrtle is an evergreen perennial shrub up to 3 m tall, the crown is dense, multi–branched; young shoots are tetrahedral, greenish gray; 2–3-year-old shoots are rounded or slightly faceted, gray or gray–brown. The leaves are glandular opposite, ovate to lanceolate, 2–5 cm long, 1–2.5 cm wide, pointed, whole-edged, leathery, fragrant when rubbed. The flowers are white, arranged one at a time on short pedicels. Blooms in late May and all of June. The fruit is a bluish black (sometimes white), multi-seeded berry, 10–12 mm long and 5–6 mm wide. There are 5–15 seeds in each fruit. The fruits look like round white berries, have a spicy sweet taste and ripen in November–December [12]. It grows in subtropical countries: South America, North Africa, Southern Europe, northwest India, Australia, the Middle East and Western Asia [13]. The *Myrtaceae* family includes 100 genera and 3 000 species. In the Russian Federation, common myrtle grows and is cultivated on the territory of the Republic of Crimea (Nikitsky Botanical Garden, Yalta), as well as in the Caucasus and Krasnodar Territory [14].

Currently, myrtle is not a pharmacopoeial plant in Russia, although it is included in foreign pharmacopoeias[2, 3]. Moreover, the presence of antimicrobial and antifungal effects of extracts from the leaves of this plant encourage Russian scientists to actively explore the possibilities of using this type of MPRM in medical practice.

THE AIM. An analysis and comparative study of the antibacterial activity of samples of extracts obtained with ethanol of various concentrations and infusion of myrtle leaves (*Myrtus communis* L.) against to clinical strains isolated from patients with cystic fibrosis.

MATERIALS AND METHODS

Water-alcohol extracts from myrtle leaves based on ethanol of the chemically pure category (concentrations of 40, 70 and 96%) in the ratio "raw material–extractant" — 1:5 were used as objects of study. Common myrtle leaves were harvested and dried at the Order of the Red Banner of Labor Nikitsky Botanical Garden – National Scientific Center (NBG-NSC) in July 2022 in Yalta, Republic of Crimea, Russian Federation, provided under a scientific cooperation agreement with the Department of Pharmacognosy with the Basics of Phytotherapy of the Samara State Medical University. The raw materials were dried in the air without direct sunlight. The species specificity of the object was confirmed with the help of relevant scientific papers [15–17], as well as herbarium specimens from the herbarium fund of the NBG-NSC[4].

Preparations for comparison and control samples with established antimicrobial activity were ethanol of analytical grade in several main concentrations (40, 70 and 96%) and tincture of *Eucalyptus viminalis* L. 70% produced by Tula Pharmaceutical Factory LLC (series 21112), Russia. To prepare solutions of ethanol 40 and 70%, ethanol 96%, Hippocrates LLC (series 380221), Russia, was used.

The following strains of pathogenic microorganisms isolated from the sputum of patients with cystic fibrosis were used as test cultures: *Pseudomonas aeruginosa* (strain 1), *Pseudomonas aeruginosa* (mucoid strain 2), *Stenotrophomonas maltophilia, Burkholderia cenocepacia* and *Chryseobacterium indologenes.*

The strains of microorganisms included in the

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[4] Herbaria of the Nikitsky Botanical Garden. Available from: https://nikitasad.ru/science/gerbarij-nikitskogo-botanicheskogo-sada. Russian

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study were obtained by experienced scientists of the Microbiological Department of the Clinical Diagnostic Laboratory of the Samara State Medical University clinics in accordance with the conclusion of the Bioethics Committee at the Samara State Medical University (extract from Protocol No. 204 of December 11, 2019). The patients underwent microbiological examination on an outpatient basis in accordance with the National Clinical Guidelines of the Russian Federation "Cystic fibrosis"[5].

To conduct the experiment, water-alcohol extracts were obtained from common myrtle leaves by the method of fractional percolation described in the GPhM.1.4.1.0019[6] of the State Pharmacopeia of the Russian Federation XV edition (SPh RF XV ed.), as well as an aqueous infusion of myrtle leaves according to the GPhM.1.4.1.0018[7] SPh RF XV ed.

Methodology

Preparation of the working solution

A micromethod was used for the study: testing was performed at a final volume of 100 µl. Working solutions were introduced into micro-dilution plates of 50 µl per well. Using multichannel pipettes, a 96-well sterile tablet for immunological studies (with a flat bottom) with a lid was filled with double serial dilutions of the investigated extracts. The dilutions were then inoculated with a prepared suspension of the investigated microorganism. Incubation was carried out in a normal atmosphere at a temperature of 36°C. During incubation, the tablet was covered with a lid to prevent the contents of the wells from drying out.

Preparation of inoculum

Inoculum was prepared by suspending colonies selected from a nocturnal culture grown on 5% blood agar (HiMedia, India). The final microbial load in the inoculum was 5 = 105 CFU/mL. To prepare the inoculum with the required concentration of microorganisms, 100 µl of a suspension equivalent to 0.5 according to the McFarland standard was used, which was transferred to a test tube containing 9.9 ml (1:100 dilution) of broth, which made it possible to obtain a suspension with a cell concentration of 1×106 CFU/mL, with the addition of 50 µl of which to an equal volume (50 µl) of the test substance The final composition of the inoculum was obtained from the solution. Inoculum was introduced into test tubes with dilutions of the sample no later than 15 minutes after its preparation. The plates with the tested strains were incubated at 36°C for 24 hours.

Assessment of microbial growth

The determination of the minimum inhibitory concentration (MIC) and antimicrobial activity was carried out by double serial dilution in broth on test cultures isolated from sputum from patients with cystic fibrosis[8]. To determine the presence of microbial growth, the wells of the crop plates were viewed in transmitted light. The growth of the culture in the presence of the test sample was observed when compared with the hole of the "negative" control. MIC was determined by the lowest concentration of the test sample, which suppresses the visible growth of microorganisms.

Evaluation of experimental results

The results of microbiological analysis were recorded 48–72 hours after incubation at a temperature of 36°C. From wells with appropriate dilutions of the studied samples with visible growth retardation, seeding was carried out on nutrient media (5% blood agar-agar (HiMedia, India)). After 24 hours, the absence of growth was assessed as a bactericidal effect, and the appearance of visible growth, but with its delay, as bacteriostatic. At the same time, according to the requirements of GOST R ISO 20776-1-2010[9], as well as the recommendations of the Performance Standard for Antimicrobial Sensitivity tests (CLSI)[10], the presence of turbidity and the detection of a small number of microorganisms (1 colony) were not considered when registering the experimental result. The number of repetitions of each experiment was 3.

RESULTS AND DISCUSSION

As a result of the study, it was found that all water-alcohol extracts from myrtle leaves showed obvious antimicrobial activity, surpassing the control alcohol samples of concentrations 40, 70 and 96 for *Burkholderia cenocepacia, Stenotrophomonas maltophilia* and

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[7] GPhM.1.4.1.0018 Infusions and decoctions. The State Pharmacopoeia of the Russian Federation XV ed. Available from: https://pharmacopoeia.regmed.ru/pharmacopoeia/izdanie-15/1/1-4/1-4-1-lekarstvennye-formy/nastoi-i-otvary/?sphrase_ id=230971

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[9] GOST R ISO 20776-1-2010 "Clinical laboratory tests and diagnostic test systems in vitro"; 2012. Available from: https://protect.gost.ru/document.aspx?control=7&id=177197. Russian

[10] Clinical and Laboratory Standards Institute (CLSI). Performance Standards for Antimicrobial Disk Susceptibility Tests. 13th ed. CLSI standard M02. Clinical and Laboratory Standards Institute, 950 West Valley Road, Suite 2500, Wayne, Pennsylvania 19087 USA; 2018.

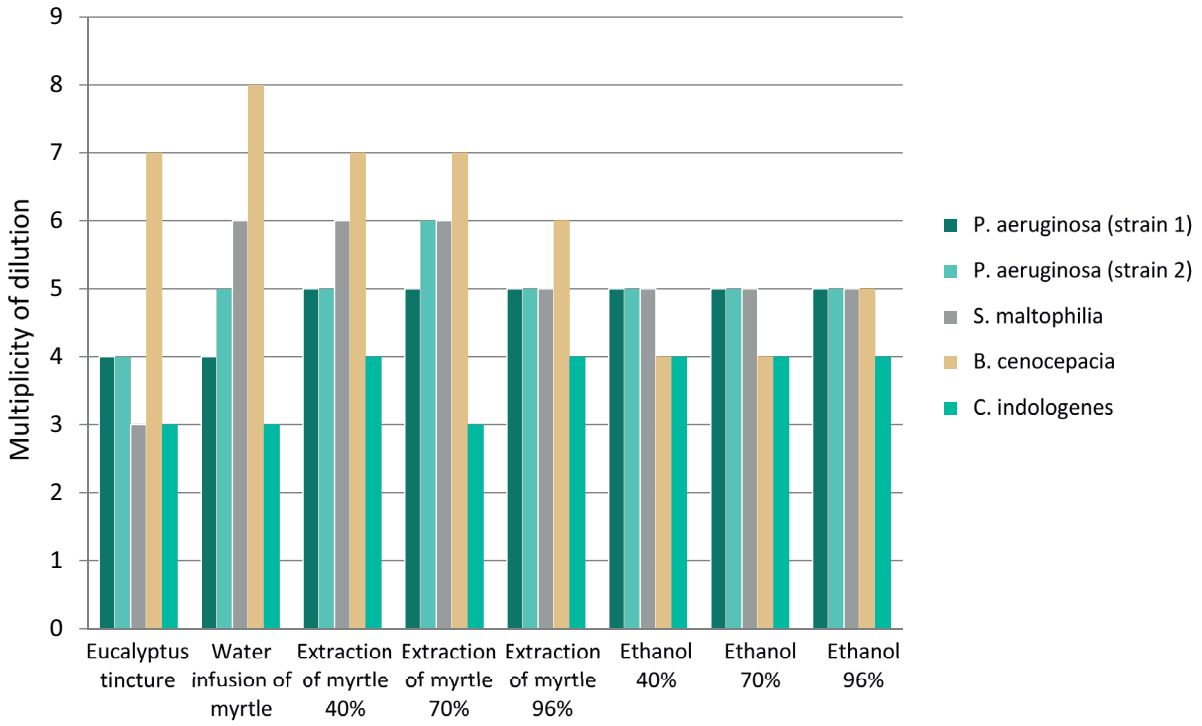

Figure 1 – Comparative diagram of the antibacterial activity of water-alcohol extracts of common myrtle leaves.

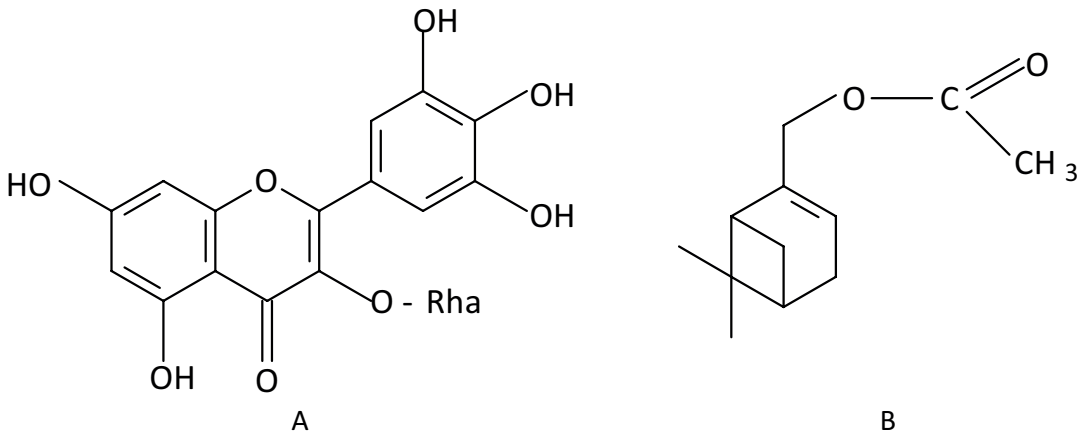

Figure 2 – Structural formulas of myricitrin (A) and myrtenyl acetate (B).

Pseudomonas aeruginosa strains (mucoid strain 2), and surpassing the comparison sample of eucalyptus tincture for individual strains (Table 1). For two strains (*Pseudomonas aeruginosa* strain 1 and *Chryseobacterium indologenes*), no pronounced antimicrobial activity was detected in the study objects, and the effect was comparable with the control samples (Table 2).

Of all the studied objects, according to the severity of the antimicrobial effect, 2 samples can be distinguished — tincture of myrtle leaves 70% and an aqueous infusion (Fig. 1).

Common myrtle leaf tincture 70% shows the widest bactericidal and bacteriostatic activity among all studied objects in relation to 3 clinical strains of *Burkholderia cenocepacia, Stenotrophomonas maltophilia* and *Pseudomonas aeruginosa* (strain 2 mucoid). With respect to the *Burkholderia cenocepacia* strain, the antimicrobial effect of myrtle leaf tincture 70% is comparable to eucalyptus tincture but surpasses it in bactericidal and bacteriostatic activity for two other strains, and also surpasses control samples of ethanol with concentrations of 40, 70 and 96% for all 3 strains by several dilution positions.

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Table 1 – Results of testing extracts of common myrtle leaves (*M. communis* L.) and comparison preparations

Object	Multiplicity of dilution							
	1	2	3	4	5	6	7	8
	1:2	1:4	1:8	1:16	1:32	1:64	1:128	1:256
Pseudomonas aeruginosa (strain 1)								
Extraction of myrtle 40%	–	–	–	–	–	+	+	+
Extraction of myrtle 70%	–	–	–	–	–	+	+	+
Extraction of myrtle 96%	–	–	–	–	–	+	+	+
Water infusion of myrtle	–	–	–	–	+	+	+	+
Tincture of eucalyptus 70%	–	–	–	–	+	+	+	+
Pseudomonas aeruginosa (strain 2)								
Extraction of myrtle 40%	–	–	–	–	–	+	+	+
Extraction of myrtle 70%	–	–	–	–	–	–	+	+
Extraction of myrtle 96%	–	–	–	–	–	+	+	+
Water infusion of myrtle	–	–	–	–	–	+	+	+
Tincture of eucalyptus 70%	–	–	–	–	+	+	+	+
Stenotrophomonas maltophilia								
Extraction of myrtle 40%	–	–	–	–	–	–	+	+
Extraction of myrtle 70%	–	–	–	–	–	–	+	+
Extraction of myrtle 96%	–	–	–	–	–	+	+	+
Water infusion of myrtle	–	–	–	–	–	–	+	+
Tincture of eucalyptus 70%	–	–	–	+	+	+	+	+
Burkholderia cenocepacia								
Extraction of myrtle 40%	–	–	–	–	–	–	–	+
Extraction of myrtle 70%	–	–	–	–	–	–	–	+
Extraction of myrtle 96%	–	–	–	–	–	–	+	+
Water infusion of myrtle	–	–	–	–	–	–	–	–
Tincture of eucalyptus 70%	–	–	–	–	–	–	–	+
Chryseobacterium indologenes								
Extraction of myrtle 40%	–	–	–	–	+	+	+	+
Extraction of myrtle 70%	–	–	–	+	+	+	+	+
Extraction of myrtle 96%	–	–	–	+	+	+	+	+
Water infusion of myrtle	–	–	–	+	+	+	+	+
Eucalyptus tincture 70%	–	–	–	+	+	+	+	+

Table 2 – Minimum suppressive concentrations of ethanol (“negative” control)

Object	Multiplicity of dilution*							
	1	2	3	4	5	6	7	8
	1:2	1:4	1:8	1:16	1:32	1:64	1:128	1:256
Pseudomonas aeruginosa (strain 1)								
Ethanol 40%	–	–	–	–	–	+	+	+
Ethanol 70%	–	–	–	–	–	+	+	+
Ethanol 96%	–	–	–	–	–	+	+	+
Pseudomonas aeruginosa (strain 2)								
Ethanol 40%	–	–	–	–	–	+	+	+
Ethanol 70%	–	–	–	–	–	+	+	+
Ethanol 96%	–	–	–	–	–	+	+	+
Stenotrophomonas maltophilia								
Ethanol 40%	–	–	–	–	–	+	+	+
Ethanol 70%	–	–	–	–	–	+	+	+
Ethanol 96%	–	–	–	–	–	+	+	+
Burkholderia cenocepacia								
Ethanol 40%	–	–	–	–	+	+	+	+
Ethanol 70%	–	–	–	–	+	+	+	+
Ethanol 96%	–	–	–	–	–	+	+	+
Chryseobacterium indologenes								
Ethanol 40%	–	–	–	–	+	+	+	+
Ethanol 70%	–	–	–	–	+	+	+	+
Ethanol 96%	–	–	–	–	+	+	+	+

The pronounced antimicrobial and antifungal activity of myrtle extracts is due to its component composition, in which the flavonoid myricitrin (3-*O*-α-L-rhamnopyranoside of myricetin) and myrtenyl acetate are the dominant BACs[11, 12, 13] (Fig. 2).

It should be noted that 70% ethanol is the optimal extractant for most flavonoid-containing plants, since this concentration of ethanol allows for maximum extraction of the number of flavonoids present in the plant and has a better penetrating ability into the deep layers of the epidermis compared with higher concentrations [18]. In addition, compounds of a terpenoid nature also enter the liquid phase, as we have established during preliminary phytochemical studies. Phenolic substances in the leaves of myrtle are maximally extracted at an ethanol concentration of 70–80% [19].

Foreign clinical and experimental studies show that myrtle leaves, unlike fruits, have a wider range of pharmacological and therapeutic effects, especially such as antibacterial and antifungal [11]. Many foreign studies focus on the antimicrobial activity of water-alcohol extracts from myrtle [20–22]. The antibacterial activity of alcohol extracts of *Myrtus communis* L. was studied by G. Alipour et al. based on 6 gram-positive (*Staphylococcus aureus, Micrococcus luteus, Streptococcus pneumoniae, Streptococcus pyogenes, Streptococcus agalactiae, Listeria monocytogenes*) and 4 gram-negative (*Escherichia coli, Proteus vulgaris, Pseudomonas aeruginosa* and *Campylobacter jejuni*) bacteria and, according to the results of the study, alcohol extract from myrtle leaves inhibited the growth of all mentioned bacteria, except for the *Campylobacte jejuni* strain. [11]. Moreover, myrtle leaves are a raw source of BACs, which have antimicrobial effects in the treatment of tuberculosis, including against strains of pathogenic bacteria such as *Pseudomonas aeruginosa* [23]. Aquatic extracts of common myrtle leaves (*Myrtus communis* L.) from the southwestern Zagros region in Iran were evaluated. Even though they have antibacterial properties against *Escherichia coli, Bacillus subtilis* and *Pseudomonas aeruginosa* due to the dominant presence of gallic acid, antifungal activity against *Aspergillus oryzae* has not been observed [24].

The antibacterial activity of alcohol extract of myrtle leaves (*Myrtus communis* L.) was evaluated by MIC, MBC and the size of the inhibition zone against Gram-positive bacteria. Alcoholic myrtle extract demonstrated a significant inhibitory effect against Gram-positive and acid-resistant bacteria, while not affecting the growth of Gram-negative bacteria [25].

The aqueous infusion of myrtle leaves surpassed in bactericidal and bacteriostatic activity the control samples of ethanol with concentrations of 40, 70 and 96% and eucalyptus tincture in relation *to Stenotrophomonas maltophilia* and *Burkholderia cenocepacia* strains. Perhaps this is due to the maximum extraction of gallic acid from an aqueous solution of common myrtle. Also, due to the presence of gallomyrtucommodones in water-alcohol extracts obtained from myrtle leaves, positive results in antimicrobial activity are observed, including against mucoid strains [20].

Thus, water-alcohol extracts from myrtle leaves have antibacterial activity, which may be related to the ability of BACs to inactivate cell membrane transport proteins, enzymes, and microbial adhesion [26]. The mechanisms of antibacterial activity are due to the high content of monoterpene hydrocarbons such as α-pinene, limonene, eucalyptol, linalool, and terpineol, which contribute to the pronounced antimicrobial activity of *M. communis* L. [27, 28]. In addition, an important characteristic of myrtle essential oil and its components is their hydrophobic nature, which allows them to penetrate the lipids of the bacterial cell membrane and disrupt cell function [29]. One of the factors affecting the qualitative composition of the oil, and, accordingly, the degree of severity of the bactericidal and bacteriostatic effects of extracts from MPRM of common myrtle, is its ecological and geographical area of cultivation. It should be borne in mind that there are two main points of view regarding what are the main components of common myrtle essential oil: 1,8-cineol, α-pinene or myrtenyl acetate. Undoubtedly, we can say that both options are correct. While 1,8-cineol and α-pinene predominate in species found in Greece, Italy, France, and Algeria, myrtenyl acetate is found in Portugal, Morocco, Spain, Tunisia, and Albania [30], as well as in Crimea and Krasnodar Territory (Russian Federation).

In the essential oil of myrtle plants of Tunisian and French origin, α-pinene prevails (58.5–52.9%), in Iranian and Italian oils its content is 35–41.6%, which allows it to be attributed to the α-pinene chemotype. The oil obtained in Serbia accumulates the maximum

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amount of linalool (35.7%) and, accordingly, the linalool chemotype can be isolated. The maximum amount of myrtenyl acetate is contained in the oil of winter-hardy myrtle varieties (49.6%) [12]. It can be attributed to the myrtenyl acetate chemotype. The content of 1,8-cineol ranges from 21.6% (Tunisia) to 32.9% (France). These oils, including the one we studied, can be attributed to the 1,8-cineolic chemotype [31]. Thus, the ethereal identity of *Myrtus communis* L. in the conditions of a dry subtropical Mediterranean climate on the southern coast of Crimea, it is 2 times higher than in humid subtropics. An analysis of the biochemical composition of the essential oil indicates a high level of common myrtle myrtenyl acetate (49.6%) and other esters in Crimean myrtle oil, while in humid subtropical conditions significantly more 1,8-cineol is formed [32], which undoubtedly affects the results of studies on antimicrobial activity.

The data obtained during the study indicate that the raw materials of common myrtle leaves are superior in bactericidal and bacteriostatic activity to the medicinal raw materials of the pharmacopoeial plant *Eucalyptus viminalis* L., which provides additional and weighty arguments for the formation of a draft pharmacopoeial article for a new MPRM — Common Myrtle Leaves.

The problem of microbial resistance is growing, and the prospects for the use of antimicrobial drugs in the future are unclear. The vegetable raw materials of myrtle have both pronounced bactericidal and bacteriostatic, antifungal activity, in comparison with ethanol and eucalyptus tincture. Water-alcohol extracts from myrtle based on various concentrations of ethanol (40 and 70%) can be a source of bioflavonoids to develop new medicines with antimicrobial effects based on them. Thus, common myrtle leaves are of interest for further research as a potential MPRM for the treatment of infectious diseases, including in patients with a genetically determined diagnosis of cystic fibrosis.

CONCLUSION

All the studied samples of water-alcohol extracts from common myrtle leaves exhibit antibacterial activity against strains obtained from patients with cystic fibrosis. It was found that the bactericidal and bacteriostatic activity of common myrtle leaf tincture in 70% alcohol is the most active against three clinical strains of *Burkholderia cenocepacia, Stenotrophomonas maltophilia* and *Pseudomonas aeruginosa* (mucoid strain 2), among the studied objects and surpasses the comparison samples in effect. The aqueous infusion of common myrtle leaves surpassed the antimicrobial activity of ethanol samples and eucalyptus tincture in relation to *Stenotrophomonas maltophilia* and *Burkholderia cenocepacia* strains.;

The data obtained during the research allow us to draw conclusions about the future prospects of studying 70% and aqueous infusion of common myrtle leaves for the creation and implementation of medicines based on them in medical and pharmaceutical practice.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHORS' CONTRIBUTON

Vera D. Maslova — literature analysis, conducting an experiment, data analyzing and interpreting, preparing a draft of the article; Vladimir A. Kurkin — final approval of the article for publication, analysis of the results, critical analysis of the intellectual content; Vitaly M. Ryzhov — development of the concept and design of the study; Artem V. Lyamin — conducting microbiological research, participation in description and analysis of the results; Olga V. Kondratenko — selection of strains of microorganisms, participation in the description and analysis of the results; Nadezhda N. Bakova — collection and identification of raw materials, processing of results, writing of the article; Ekaterina Yu. Bakova — collection and identification of raw materials, preparation of plant material for research, processing of results. All authors confirm that their authorship meets the international ICMJE criteria (all authors made a significant contribution to the development of the concept and preparation of the article, read and approved the final version before publication)

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