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Comparative Analysis of Antimicrobial Effects of Essential Oils from Various Plants from Azerbaijan Flora

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***Annotation*:** Regarding the treatment of diseases caused by microorganisms substances, drugs and other means used in therapeutic and preventive measures carried out in many countries of the world, including Azerbaijan obtained either from natural sources or by synthesis [1,2]. A decrease in the effect of the substances used over time or the emergence of resistant forms of microorganisms to their effects is necessary to constantly search for new methods and approaches to keep this issue in the centre of attention and to eliminate the pathologies caused by microorganisms [3]. Currently in the world, including in Azerbaijan increased resistance of some microorganisms to antibiotics leads to serious problems, especially in the treatment of hospital-acquired infections. Massive use of antibiotics of extremely complex chemical composition leads to the emergence of resistance, as well as a number of side effects (dysbiosis, dysbacteriosis, allergic reactions, weakening of the immune system, etc.). There is a great need for new antimicrobial drugs against microbes included by the World Health Organization (WHO) as priority pathogens (for example, gram-negative bacteria, carbapenem-resistant bacteria, methicillin-resistant staphylococci, etc.) [4]. In this regard, it seems more reasonable to use preparations of essential oils of medicinal plants, which have an antimicrobial effect, but have fewer side effects than known antibiotics. Currently, essential oil preparations are widely used, studied in recent years as a result of numerous studies conducted throughout the world [5]. It is known that the number of essential oil plants of the modern world flora ranges from 2500 to 3000 species. [6]. In our republic, which has rich plant resources, the study of plants, especially wild essential oil plants, has recently become one of the most important areas of scientific study. It is also worth noting that up to 800 of the 4,500 plant species in the flora of Azerbaijan are considered essential oil plants. The main reason why these plants have become the subject of study both in the world and in our country is that they are used for various purposes and no harmful effects are found after use. Essential oils penetrate the cell and damage the cytoplasmic membrane of microorganisms, at this time, the activity of microorganisms decreases with aerobic respiration. For this reason, drugs in the form of biologically active dietary supplements of plant origin have recently become widely used in practical medicine [5,6].

***Key words**: medicinal plants, essential oils, pathogenic microorganism*

Taking into account the above, the plants used today in folk medicine constitute a small part of all essential oil plants [8]. All this makes the study of basic plants in this regard one of the urgent tasks of modern microbiological science. Indeed, in Azerbaijan, as well as throughout the world, many studies have been carried out in this direction and promising results have been obtained, however, if we take into account that our republic has a rich nature and the areas of application of essential oil plants are expanding every day, it is safe to say that it is important to continue study in this direction, as well as expand the scope of study [2,7,8].

Considering the all of the above, 6 essential plants of the Azerbaijani flora were selected for the study.

Mountain mint (ziziphora zigida) is the most famous of the known varieties of mint and is used in medicine, industry and cooking. Study confirms that mint kills bacteria that cause food poisoning and other infectious

diseases [5]. Other 16 species of mint growing in the flora of Azerbaijan (mountain mint, field mint, water mint, etc.) are very relevant from a medical point of view and are included in a number of drugs [7,9].

Annual chives (Stachys annua) - has pharmacological properties (anti-inflammatory, wound-healing, expectorant, hemostatic, choleretic, diuretic, sedative, etc.) and can be used in the treatment of many diseases. Vaccines contained in the plant have anti-inflammatory and antibacterial effects [7,9].

Common cumin (Carum carvi) – has a strong antifungal, antibacterial, antiviral, anthelmintic effect, relieves itching, regenerates inflamed areas of the skin, has a diuretic, choleretic, and mild laxative effect. Stimulates the synthesis of immunomodulators (interferons), thereby neutralizing infectious aggression. It has an anti-inflammatory effect at the local and general level, eliminates cold symptoms [1,7,8].

Thyme creeping (Thymus vulgaris) – the composition of thyme oil is quite variable, with phenol usually being the most prominent. Thyme has been used in folk medicine since ancient times, mainly as a cold medicine. Since it has antiperspirant, expectorant and antiseptic properties, it can be used as a useful medicine in the treatment of diseases such as laryngitis, bronchitis, whooping cough and pneumonia [1,7,9].

Lemon (Citrus limon L. Burm.) - has antiviral, antibacterial, antiseptic, immunostimulating, antispasmodic, antirheumatic, choleretic, diuretic properties, due to its wide spectrum of action it is used in aromatherapy. It normalizes blood pressure and relieves headaches. It is used in the treatment of anemia, respiratory diseases, food poisoning and gastrointestinal system diseases. Lemon oil normalizes metabolism, relieves headaches, helps with stomatitis and periodontal diseases[1,7].

Pine cones essential oil (Pinus sylvestris L.) – in folk medicine, Pine cones essential oil is widely used in diseases of the gastrointestinal tract, bullitis, chronic pancreatitis and stomach ulcers. The spectrum of action of essential oils obtained from shoots and cones of various pine species is diverse: they have antiseptic, disinfectant, restorative, anti-inflammatory, diuretic and other effects, but their main feature is their use in infections of the upper respiratory tract. 1,7,9].

The aim of the study is to examine the antimicrobial properties of essential oils obtained from wild mountain mint, lemon, Common cumin , Thyme creeping Pine cones and Annual chives medicinal herb plants.

Materials and methods: studies were carried out at the Department of Medical Microbiology and Immunology of Azerbaijan Medical University. The materials used are essential oils obtained from various plants belonging to the Azerbaijani flora.

Substance 1 - Mountain mint essential oil (ziziphora zigida)

Substance 2 - Annual chives oil (Stachys annua)

Substance 3 – Lemon oil (*Citrus limon L. Burm*.)

Substance 4 - Common cumin oil (Carum carvi)

Substance 5 - Thyme creeping oil (Thymus vulgaris)

Substance 6 - Pine cones essential oil (Pinus sylvestris L.)

The antibacterial and antifungal properties of substances were studied using the disk diffusion method. MRSA - methicillin-resistant ***Staphylococcus aureus*** was chosen as a representative of gram-positive bacteria as a test culture, ***Esherichia coli*** and ***Pseudomonas aeruginosa*** from gram-negative bacteria, ***Candida albicans*** from yeast-like fungi were selected as representatives of fungi, ***Bacillus anthracoides*** was selected as a representative of spore-forming gram-positive rod-shaped bacteria, and ***Klebsiella pneumonie*** was selected as a representative of capsular bacteria.

By the disk diffusion method, a suspension is prepared from the daily culture of microorganisms according to the 0.5 MacFarland turbidity standard. Individual microbial suspensions are then poured into Petri dishes containing meat peptone agar (EPA) and Sabouraud agar. Sterile discs soaked in the test substance for 3-5 minutes are placed on the surface of a nutrient medium inoculated with microbes. Sterile petroleum jelly was

used as a control. Then, MPA seedlings are placed in a thermostat at 37°C, and seedlings are placed in Sabouraud medium at 28°C, and the results are recorded after 24-48 hours (Table 1).

Antimicrobial activity of the studied samples Table 1

Test culture	***The substances studied***						
	Substance 1 ***Mountain mint essential oil (ziziphora zigida)***	***Substance 2 Annual chives oil (Stachys annua)***	***Substance 3*** ***Lemon oil (Citrus limon L. Burm.)***	***Substance 4*** ***Common cumin oil (Carum carvi) oil***	***Subsratance 5*** ***Thyme creeping oil (Thymus vulgaris)***	***Maddə 6*** ***Pine cones essential oil (Pinus sylvestris L.)***	***K*** ***Sterile petroleum jelly***
S.aureus	***8 mm***	***16 mm***	***16 mm***	***31 mm***	***22 mm***	***3 mm***	***0 mm***
E.coli	***5 mm***	***29 mm***	***15 mm***	***21 mm***	***18 mm***	***8 mm***	***0 mm***
P.aeruginoza	***9 mm***	***14 mm***	***14 mm***	***15 mm***	***13 mm***	***3 mm***	***0 mm***
C.albicans	***20 mm***	***31 mm***	***11 mm***	***18 mm***	***16 mm***	***13 mm***	***0 mm***
K.pneumoniae	***16 mm***	***20 mm***	***20 mm***	***14 mm***	***11 mm***	***5 mm***	***0 mm***
B.anthracoides	***20 mm***	***31 mm***	***5 mm***	***11 mm***	***9 mm***	***6 mm***	***0 mm***

Note: The numbers indicate the diameter of the sterile zones in mm. All experiments were repeated 3-5 times.

Result and discussion: As a result of the study, it was determined that each of the 6 essential oils presented had different antimicrobial and antifungal effects.

For this reason, ***Substance 1 - Mountain mint oil (Ziziphora zigida***) had a more active effect on test cultures of C. albicans yeast-like fungi and B. anthracoides selected as representatives of spore-forming gram-positive rods (inhibition zone 20 mm). A slightly weak effect on K.pneumoniae culture (16 mm) and a very weak effect on S.aureus, E.coli and P.aeruginosa cultures (inhibition zones 5-9 mm) were noted.

Substance 2 - Annual chives oil (Stachys annua) showed a significant antifungal and antibacterial effect and stopped the growth of test cultures of C. albicans and B. anthracoides with a diameter of 31 mm. A similar antibacterial effect (29 mM) was also noted against Escherichia coli culture. The remaining 3 bacteria (K.pneumoniae, S.aureus and P.aeruginosa) were moderately affected by this substance, and the inhibition zones ranged between 14-20 mm.

Substance 3 - The zone of maximum inhibition of ***lemon oil (Citrus limon L. Burm.)*** was against K. pneumoniae, a representative of capsular bacteria (20 mm), and the smallest effect was against B. anthracoides culture - 5 mm. The effect on other test cultures was determined by the inhibition zone of 11-16 mm.

Substance 4 - Common cumin oil (Carum carvi) had the strongest effect on MRSA - methicillin-resistant test culture S. aureus, the zone of inhibition was 31 mm. A slightly weaker effect (21 mm) was noted for Escherichia coli culture. Zones of inhibition ranged from 11-18 mm and had a moderate effect on other test cultures.

Substance 5 - Thyme creeping oil (Thymus Vulgaris) had the strongest effect (22 mm) against the test culture of S. aureus, was moderately effective against Escherichia coli and C. albicans cultures (inhibition zones 18 mm

and 16 mm, respectively) and had a weak effect on the remaining 3 test cultures; Zones of inhibition ranged from 9 to 13 mm.

Substance 6 - Pine cones essential oil (Pinus sylvestris L.) had a relatively weak effect compared to other samples. So, if an inhibition zone of 13 mm was recorded only for the fungus C. albicans, for other crops these figures are 3-8 mm.

Sterile petroleum jelly used as control had no antimicrobial properties.

Recent studies have shown that the 6 essential oils studied have an antimicrobial effect on selected test cultures.

Substance 4, Common cumin oil (Carum carvi), showed the strongest antibacterial effect, and this effect decreased in the following order:

Substance 4 → Substance 2 → Substance 5 → Substance 3 → Substance 1 → Substance 6.

The strongest antifungal effect was exhibited by substance 2, annual chives oil (stachys annua) oil, and this effect decreased in the following order:

Substance 2 → Substance 1 → Substance 4 → Substance 5 → Substance 6 → Substance 3.

Therefore, it should be noted that the 6 essential oils examined as a result of the study had an antimicrobial effect on the selected test cultures. Among them, Common cumin oil, Annual chives oil, Thyme creeping oil , and lemon oil generally showed strong antimicrobial activity, while mountain mint oil and Pine cones essentialoil generally showed weak antimicrobial activity. The strongest antibacterial effect was found in Common cumin oil (Carum carvi), and the strongest antifungal effect was found in Annual chives oil .

Summary

The present article reports on a study work carried out to study the antimicrobial properties of 6 essential oils: mountain mint (Ziziphora zigida), annual chives (Stachys annua), lemon (Citrus limon L. Burm.), Common cumin (Carum carvi), thyme creeping (Thymus Vulgaris) and pine cones (Pinus sylvestris L.) in relation to the selected test crops. Studies have shown that each of the 6 essential oils has moderate to moderate antimicrobial and antifungal activity.Of these, the oils of common cumin, annual chistetsa, creeping thyme and lemon have a high overall antimicrobial activity, oils of hard mountain mint and pine cones have a weak one. The highest antibacterial activity was found in the essential oil of common cumin (Carum carvi), and the highest antifungal activity was found in the essential oil of the annual chives (Stachys annua).

References

[1] Seyidova G.M., Suleymanova T.Kh., Azizova A.N."Antimicrobial and antifungal properties of oil of lemon, fennel, sauce obtained from representatives of the flora of Azerbaijan". Azerbaijan Medical Achievements #1,2022, p. 138-141

[2] Jalililova S.G., Garayev Z.O., Zeynalova S.G., Muradova S.A. “The influence of the newly obtained series of essential oils on representatives of gram-negative bacteria” // ANAS news collection 167, Ganja, 2017, pp. 32-35.

[3] Ibadullayeva S.J., Jafarli I.A. Essential oils and aromatherapy. Baku, "Elm" publishing house, 2007, 119 pages.

[4] Antibacterial agents in clinical and preclinical development: an overview and analysis. World Health Organization, 2022.

[5] Sharapaeva M.S., Lesovskaya M.I. “The relationship between the bactericidal and antioxidant properties of essential oils // Problems of modern science and education. – 2011. – No. 6. 12/19/2011. Biological Sciences. UDC-574. 02/03/08

[6] Tishchenko I. Yu., Filimonova N. I. “Antimicrobial activity of essential oils of mint, salvia officinalis, Pine cones and lemon balm.” Department of Microbiology, Virology and Immunology. National Pharmaceutical University, Kharkov, Ukraine microbiology@nuph.edu.ua

[7] Gurinovich L.K., Puchkova T.V. Essential oils: chemistry, technology, analysis and application. Moscow, School of Cosmetic Chemists, 2005, 98 p.
[8] Suleymanov T.A., Kirimer N.,Kurkcuoqlu M, Shukurova A. Essential oil constituents of phlonis punqeus wield. From Azerbaijan//Journal of essential oil bearinq plants, 2017,vol.20, №6, p.1492-1501.
[9] Bakshaliyeva K.F., Ismaylova G.E., Isayeva G.A.,Muradov P.Z. Effekt of the materials derived from some essential-oil plants on the growth of toxigenic fungi.//Ciencia e Tecnica vitivinicola(ISI Thomson Reuters,Portuqal), 2016,vol 31, № 12, p.42-46
[10] Kobzor A.D. Pharmacognosy in medicine: clinical pharmacognosy. Phytotherapy. Kyiv, 2004, 478 pp.