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**STUDY OF THE ANTIMICROBIAL PROPERTIES OF COMPOSITIONS BASED
ON ESSENTIAL OILS FROM EUCALYPTUS AND THUYA PLANTS WITH WHITE
NAPHTHALAN OIL**

- ©*Abbasov V., Y. H. Mamedaliyev's Institute of Petrochemical Processes of the Ministry of Science and Education Republic of Azerbaijan, Baku, Azerbaijan, ms.necla@mail.ru*
- ©*Ismailova G., Y. H. Mamedaliyev's Institute of Petrochemical Processes of the Ministry of Science and Education Republic of Azerbaijan, Baku, Azerbaijan*
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**ИЗУЧЕНИЕ АНТИМИКРОБНЫХ СВОЙСТВ КОМПОЗИЦИЙ
НА ОСНОВЕ ЭФИРНЫХ МАСЕЛ ИЗ РАСТЕНИЙ ЭВКАЛИПТА И ТУИ
С БЕЛЫМ НАФТАЛАНОВЫМ МАСЛОМ**

- ©*Аббасов В. М., Институт нефтехимических процессов им. акад. Ю.Г. Мамедалиева при Министерстве науки и образования Азербайджанской Республики, г. Баку, Азербайджан, ms.necla@mail.ru*
- ©*Исмаилова Г. Э., Институт нефтехимических процессов им. акад. Ю.Г. Мамедалиева при Министерстве науки и образования Азербайджанской Республики, г. Баку, Азербайджан*
- ©*Набиева Н. Д., Институт нефтехимических процессов им. акад. Ю.Г. Мамедалиева при Министерстве науки и образования Азербайджанской Республики, г. Баку, Азербайджан*
- ©*Адыгозалова Ш. Х., Институт нефтехимических процессов им. акад. Ю.Г. Мамедалиева при Министерстве науки и образования Азербайджанской Республики, г. Баку, Азербайджан*
- ©*Асадова Р. А., Институт нефтехимических процессов им. акад. Ю.Г. Мамедалиева при Министерстве науки и образования Азербайджанской Республики, г. Баку, Азербайджан*
- ©*Хамиева Г. Х., Институт нефтехимических процессов им. акад. Ю.Г. Мамедалиева при Министерстве науки и образования Азербайджанской Республики, г. Баку, Азербайджан*
- ©*Фарзалиева А. Х., Институт нефтехимических процессов им. акад. Ю.Г. Мамедалиева при Министерстве науки и образования Азербайджанской Республики, г. Баку, Азербайджан*
- ©*Мамедли А. Ш., Институт нефтехимических процессов им. акад. Ю.Г. Мамедалиева при Министерстве науки и образования Азербайджанской Республики, г. Баку, Азербайджан*
- ©*Алпашаева А. В., Институт нефтехимических процессов им. акад. Ю.Г. Мамедалиева при Министерстве науки и образования Азербайджанской Республики, г. Баку, Азербайджан*

Abstract. Cosmetic and medical oils have been widely used in medicine and cosmetology for many years. The main function of medical oils is to be a carrier in medicinal preparations. But in many cases, they perform a therapeutic function at the same time. It should be noted that for obtaining medical and cosmetic oils, low-sulfur and low-paraffin oils are more appropriate. In the context of the conducted research, the antimicrobial activity of various combinations of essential oils obtained from eucalyptus and thuja plants with therapeutic white naphthalan oil taken as a control variant was studied to clarify the effective bactericidal action mechanism. In the preparation of these compositions were prepared with the addition of therapeutic white naphthalan oil as the main component, and in addition, essential oil separated from eucalyptus and thuja plants in the ratio of 1:0,04:0,08:0,1 was analyzed for their antimicrobial effects on 4 microbes (*Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Escherichia coli*, *Candida albicans*). Medicinal and cosmetic products were determined according to the received antimicrobial effective compositions.

Аннотация. Косметические и лечебные масла уже много лет широко используются в медицине и косметологии. Основная функция медицинских масел — быть носителем в лекарственных препаратах. Но во многих случаях они одновременно выполняют и лечебную функцию. Следует отметить, что для получения медицинских и косметических масел более пригодны малосернистые и малопарафиновые масла. В рамках проведенных исследований изучена антимикробная активность различных комбинаций эфирных масел, полученных из растений эвкалипта и туи, с лечебным белым нафталановым маслом, взятым в качестве контрольного варианта, с целью выяснения механизма эффективного бактерицидного действия. При приготовлении данных композиций были приготовлены с добавлением лечебного белого нафталанового масла в качестве основного компонента, а также эфирного масла, выделенного из растений эвкалипта и туи в соотношении 1:0,04:0,08:0,1. Было проанализировано их противомикробное действие на 4 микроба (*Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Escherichia coli*, *Candida albicans*). Лекарственные и косметические средства определяли по полученным антимикробно-эффективным композициям.

Keywords: white naphthalan oil, eucalyptus oil, thuja oil.

Ключевые слова: белое нафталановое масло, эвкалиптовое масло, туюевое масло.

The chemical composition of plant-derived essential oil depends on various factors and is not stable [1]. These factors include the place where the plant is placed, the time of its collection, storage conditions, and the method of acquisition. Even the intensity of rain in the place where the plant grows affects the composition of the oil. Essential oils of vegetable origin are composed of components with carbon, hydrogen, and oxygen. In total, more than 500 organic substances have been isolated from essential oils of plant origin. Each plant-derived essential oil contains about 150 chemical fragrances. All these substances have pharmacological and therapeutic properties and therefore can affect the human body. The substances included in the composition of essential oils of plant origin are divided into several main functional groups: terpenes and terpenoids. Terpenes are potent antiviral stimulants and are divided into monoterpenes, sesquiterpenes, and diterpenes.

Monoterpenes are present in practically all essential oils and have antiseptic, bactericidal, fungicidal, antiviral, expectorant, diuretic, and immune-enhancing properties.

Sesquiterpenes (semi-terpenes) are more resistant to oxidation and less volatile. They are

found in Roman chamomile, cloves, and frankincense. Essential oils with sesquiterpenes are very thick and have a persistent smell. More than two thousand different sesquiterpenes have been isolated from the roots, wood, and green parts of plants. Sesquiterpenes have sedative, antitumor, immunostimulating, spasmolytic, analgesic, sedative, hypotensive, bactericidal, antiviral, and fungicidal properties. Essential oils contain a small number of diterpenes and have fungicidal, bactericidal, expectorant, and hormonal system-harmonizing properties. Substances included in the group of terpenoids have carbon and hydrogen as well as oxygen, and this group includes alcohols, aldehydes, ethers, ketones, phenols, and coumarins.

Research Object and Method

The purpose of the research was to study the antimicrobial effect of the compositions of medicinal white naphthalan oil and herbal essential oils (eucalyptus, thuja) in different proportions on bacteria (*Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Escherichia coli*) and fungi (*Candida albicans*). To study the effect on bacterial and fungal cultures using the test-object method, compositions in the ratio of 1:0,04:0,08:0,1 were used at different exposure times (15 min, 30 min, 1 hour, 2 hours, 3 hours, 4 hours, 5 hours, 6 hours) were used.

Due to their antiseptic and healing properties, essential oils are used in medicine and sanitary hygiene (camphor as a cardiovascular, anefol cough medicine, and eucalyptus oil as an antimicrobial and anti-parasitic agent). Some essential oils are used to improve the taste of medicines. Turpentine oil (oil-turpentine obtained from the resin of conifers) is used as varnish and paint, and eucalyptus oil is used as a reagent in the air force.

There are several methods for obtaining essential oils from plants [2]: One of them is the steam distillation method; the second method is the method of extraction with organic solvents; the third method is the enfleurage method; the fourth method is the mechanical method. The application of any of the methods depends on the morphological-anatomical characteristics of the raw materials used, and the amount and quality of these oils. In the course of the research, at the initial stage, essential oils were obtained from eucalyptus and thuja plants by steam distillation.

The steam distillation method is also called the hydro-distillation method. The hydro-distillation method is used in cases where the content of the essential oil does not change at high temperatures ($\geq 100^{\circ}\text{C}$). Note that the hydrodistillation method obeys Dalton's law of partial pressures. According to this law, the mixture begins to boil when the sum of the partial pressures of the components in the insoluble mixtures is equal to the atmospheric pressure. The hydrodistillation method is carried out in stills and continuous distillation units. As the steam passes through the raw material, it carries the essential oil with it. The mixture of water vapor and essential oil vapor cools in the cooling unit, condenses, and pours into the receiver in liquid form. It should be noted that the experience of preparing certain medicinal products based on the oils of various medicinal plants has been around for a long time, and more and more attention is being paid to this field. A laboratory conducting research in this field operates at the Institute of Petrochemical Processes named after Academician Y. H. Mammadaliyev of the Ministry of Science and Education of the Azerbaijan Republic. Our institute has rosemary, eucalyptus, pine, thuja, mint, juniper, cumin, anise, geranium, lemon, orange, hippophae, rose, lavender, thyme, artemisia, garlic, etc. Essential oils are obtained from plants [3–12], and as a result of preparing their compositions with white naphthalan oil, antimicrobial effective cosmetics were obtained.

Results and Discussions

Compositions were prepared by taking 1:0,04; 1:0,08 and 1:0,1 mass ratios of each eucalyptus and thuja oil with medicinal white naphthalan oil, and at different exposure times were studied their

resistance to *Pseudomonas aeruginosa*, the effects against *Staphylococcus aureus*, *Escherichia coli* bacteria and *Candida albicans* fungus (15 min, 30 min, 1 hour, 2 hours, 3 hours, 4 hours, 5 hours, 6 hours) (Figure, Table).



Figure. Image of the antibacterial activity of the composition of white naphthalan oil with camellia oil against 4 microbes in a nutrient medium

For the research, there were determined the effects of white naphthalan oil and eucalyptus and thuja oils in different proportions on *Staphylococcus aureus*. It is known that *Staphylococcus* bacteria are particularly active in immunodeficiency processes in the human body. They synthesize more than 25 protein-based toxin compounds. Gram (+) bacteria that synthesize and secrete these exotoxin compounds play an important role in the emergence of pathological diseases in the human body. Thus, pathogenic staphylococci cause dermatitis, furunculosis, furunculosis, hidradenitis, abscesses, planarity, blepharitis, periostitis, osteomyelitis, folliculitis, eczema, chronic pyoderma, meningitis, appendicitis, cholecystitis, pneumonia, enterocolitis, pyomyositis, conjunctivitis, etc. in the human body are considered the main indicator of diseases. As it can be seen, since staphylococcal bacteria are the source of many diseases in the body, it is very important to search for drugs that show antibacterial activity against them. In the course of the research, it was determined that during the effect of different compositions of white naphthalan oil and essential oil from eucalyptus on *Staphylococcus aureus* bacteria, only the 1:0,08 mass ratio composition has an antimicrobial effect starting from the exposure time of 3 hours. As a result of our research, it was found that the composition of the first 1:0,04 mass ratio of white naphthalan oil and thuja oil for 5 hours, and after increasing the concentrations, the compositions with a mass ratio of 1:0,08 and 1:0,1 starting from the exposure period of 1 hour, *Staphylococcus aureus* caused an increase in the antimicrobial activity of bacteria.

Antibacterial activities of essential oil compositions obtained from the thuja plant and white naphthalan oil obtained as a result of naphthalan oil purification [13–15] and fractionation at different temperature regimes against *Pseudomonas aeruginosa* from Gram (–) bacteria were studied. It was determined that prepared compositions based on white naphthalan oil and eucalyptus oil have no antimicrobial effect on *Pseudomonas aeruginosa* bacteria even for 6 hours.

Table

ANTIMICROBIAL EFFECT OF ESSENTIAL OILS OBTAINED
FROM EUCALYPTUS AND THUJA PLANTS WITH WHITE NAPHTALAN OIL

Names of specimens	The time of exposition (in minutes)	Names of components					
		white naphtalan oil + eucalyptus oil			white naphtalan oil + thuja oil		
		1	2	3	1	2	3
<i>Pseudomonas aeruginosa</i>	15	+	+	+	+	+	+
	30	+	+	+	+	+	+
	60	+	+	+	+	+	+
	120	+	+	+	+	+	+
	180	+	+	+	+	+	+
	240	+	+	+	+	+	+
	300	+	+	+	+	+	+
	360	+	+	+	+	+	-
<i>Staphylococcus aureus</i>	15	+	+	+	+	+	+
	30	+	+	+	+	+	+
	60	+	+	+	+	-	-
	120	+	+	+	+	-	-
	180	+	-	-	+	-	-
	240	+	-	-	+	-	-
	300	+	-	-	-	-	-
	360	+	-	-	-	-	-
<i>Escherichia coli</i>	15	+	+	+	+	+	+
	30	+	+	+	+	+	+
	60	+	+	+	+	+	+
	120	+	+	+	+	+	+
	180	+	+	+	+	+	+
	240	+	+	+	+	+	+
	300	+	+	+	+	+	+
	360	+	+	+	+	+	+
<i>Candida albicans</i>	15	+	+	+	+	+	+
	30	+	+	+	+	+	+
	60	+	+	+	+	+	+
	120	+	+	-	+	+	+
	180	+	+	-	+	+	+
	240	+	-	-	+	+	+
	300	+	-	-	+	+	+
	360	+	-	-	+	+	+

Note: 1 — 1:0,04 “+” complete finish; 2 — 1:0,08 “-” indicates the absence of finishing; 3 — 1:0,1 relative density

In the course of the study, during the antibacterial effect of the composition of white naphthalan oil with thuja oil, it was found that only the composition prepared in a mass ratio of 1:0,1 enhanced the antibacterial activity of *Pseudomonas aeruginosa* bacteria starting from the exposure period of 6 hours. In the course of the study, the antifungal effect of white naphthalan oil

and the composite forms of eucalyptus essential oil on *Candida albicans* fungi was also studied experimentally.

The composite forms prepared at a mass ratio of 1:0,04 did not have any killing effect on the fungus *Candida albicans*, and the fungal cultures showed a growth process. In the composition with a mass ratio of 1:0,08, the growth of fungi stopped only after 4 hours of exposure, and in the composition with a mass ratio of 1:0,1 the growth of fungi was stopped, which means, it has an antifungal effect. In the end, it should be noted that the results obtained in the studies on the antimicrobial activity of the compositions of the medicinal white naphthalan oil with essential oils obtained from various essential plants are quite promising. Obtaining the composites in this way from natural sources (plants) proves that their use is more promising.

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