AUXILIARY DISCIPLINES

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PHYTONCIDAL ACTIVITY OF ESSENTIAL OILS OF MEDICINAL PLANTS TO SOME STRAINS OF MOLD FUNGI

Research article

Abstract

Herbal antiseptics with phytoncidal action, for example, plant essential oils, can be used indoors in the presence of people. The antifungal activity of essential oils of medicinal plants (anis, basil, clary cage, clove, coriander, jasmine, juniper, lavender, lemon, orchid, rose, rosemary, tea tree, wormwood, ylang ylang) was evaluated by the degree of growth inhibition of mold colonies *Alternaria alternata* , *Aspergillus oryzae*, *Aspergillus flavus*, and *Cladosporium cladosporioides.* Colonies incubated in Petri dishes with a drop of essential oil on the lid under control – petrolatum. All essential oils in the experiment had phytoncidal properties. The oils were divided into groups: 1 – with fungicidal action (coriander, jasmine, orchid, rose); 2 – with high fungistatic activity to all strains (lavender, basil, tea tree oil); 3 – with fungistatic properties against individual strains (*C. cladosporioides* – rosemary and anise, *A. alternata* and *A. flavus* – lemon, *A. oryzae* – wormwood); 4 – with a stimulating effect of the growth of colonies *A. oryzae* – lemon oil.

Keywords: essential oils, fungal strains, fungistatic effect, fungicidal action, phytoncidal effect.

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ФИТОНЦИДНАЯ АКТИВНОСТЬ ЭФИРНЫХ МАСЕЛ ЛЕКАРСТВЕННЫХ РАСТЕНИЙ ПО ОТНОШЕНИЮ К НЕКОТОРЫМ ПЛЕСНЕВЫМ ГРИБАМ

Научная статья

Аннотация

Растительные антисептики с фитонцидным действием, например, растительные эфирные масла, можно использовать в помещении в присутствии людей. Противогрибковую активность эфирных масел лекарственных растений (анис, базилик, шалфей, гвоздика, кориандр, жасмин, можжевельник, лаванда, лимон, орхидея, роза, розмарин, масло чайного дерева, полынь, иланг-иланг) оценивали по степени ингибирования роста колоний плесневых грибов *Alternaria alternata*, *Aspergillus oryzae*, *Aspergillus flavus* и *Cladosporium cladosporioides*. Колонии инкубированных в чашках Петри с каплей эфирного масла на крышке при контроле – вазелиновом масле. Все эфирные масла в опыте обладали фитонцидными свойствами. Масла разделили на группы: 1 – с фунгицидным действием (кориандр, жасмин, орхидея, роза); 2 – с высокой фунгистатической активностью ко всем штаммам (лаванда, базилик, масло чайного дерева); 3 – с фунгистатическими свойствами против отдельных штаммов (*C. cladosporioides* – розмарин и анис, *A. alternata* и *A. flavus* – лимон, *A. oryzae* – полынь); 4 – со стимулирующим эффектом роста колоний *A. oryzae* – масло лимона.

Ключевые слова: эфирные масла, штаммы грибов, фунгистатический эффект, фунгицидная активность, фитонциды.

1. Introduction

A wave of legitimate anxiety in society rises in connection with an increase in indoor air pollution (if ventilation is disturbed and humidity is increased) by microscopic fungi - molds, which are producers of toxins and pathogens of allergic diseases. However, the using of disinfectants based on chemical components can lead to allergic diseases in humans, on the one hand, and resistance of microorganisms, on the other. And also, after applying chemical disinfectants, their subsequent removal is mandatory [1].

Essential oils are natural products that plants produce for certain needs (i.e. protection or attraction) other than nutrition [2]. The essence of the influence of essential oils on the vital activity of microorganisms is that they change the acid-base balance of the intercellular space, destructively affect the cytoplasmic membranes, reducing their permeability, and reduce the activity of aerobic respiration [3].

By their nature, essential oils are not simple mixtures of individual substances, but complex stabilized systems. Such systems contain compounds that maintain a certain level of oxidizing agents and reducing agents, due to which the composition of essential oils can remain stable for a long time [4].

This study aims to investigate the phytoncidal activity of the essential oil of medicinal plants in relation to some strains of mold fungi.

2. Materials and methods

The plant and fungal strains were kindly verified by Dr. Yulia Kurkina, Associate professor of Biotechnology and Microbiology in Belgorod State University (Belgorod, Russia). The aerial parts were air dried in shade at temperature (+22°C) in the room for 10 days then pulverized to fine pieces. Extraction of the essential oils in according to the European Pharmacopoeia 2007, the air dried finely grounded aerial parts of *Artemisia vulgaris* L., *Cananga odorata* (Lam.) Hook., *Caryophyllus aromaticus* L., *Citrus limon* (L.) Burm., *Coriandrum sativum* L., *Jasminum officinale* L., *Juniperus communis* L., *Lavandula officinalis* Chaix., *Melaleuca alternifolia* Cheel, *Ocimum basilicum* L., *Phalaenopsis* (*Orchidaceae* Juss), *Pimpinella anisum* L., *Rosa odorata* Thea, *Rosmarinus officinalis* L., *Salvia sclarea* L. were weighed 200 gm and subjected to hydrodistillation for extraction of the essential oil using a Clevenger type distillation apparatus for 3 hours [5]. The collected essential oil was then dried by passing over anhydrous sodium sulphate the kept at –4°C in Eppendorf tubes protected from light until analysis.

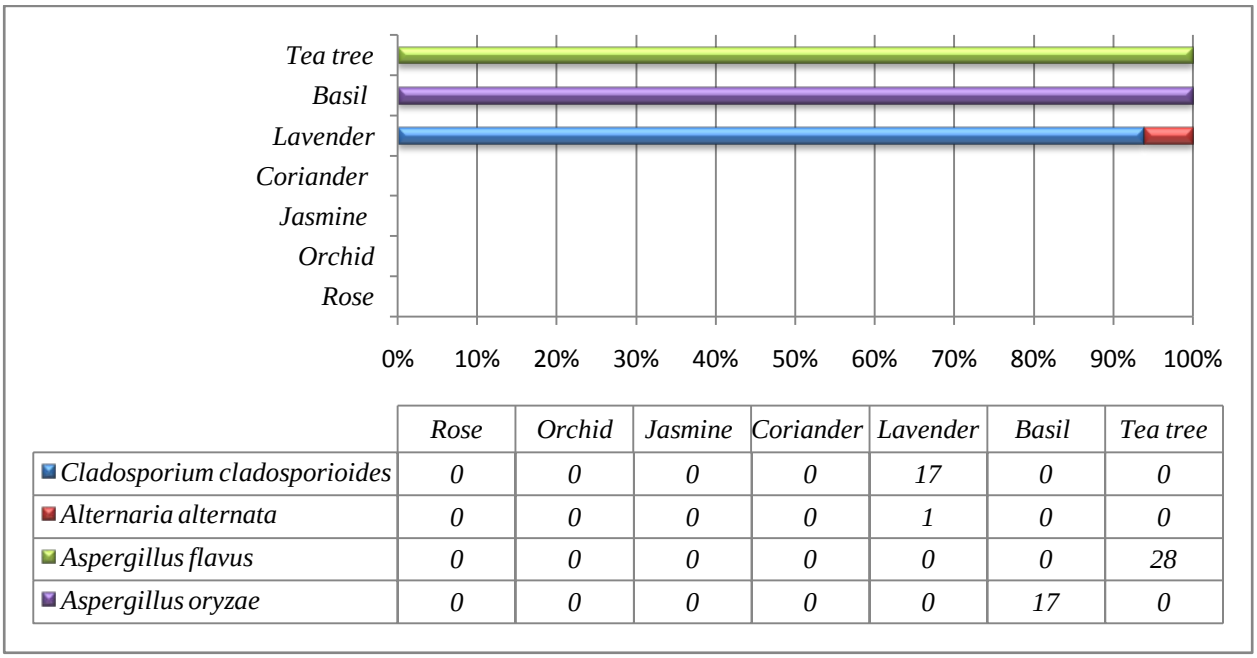
The essential oils wormwood, ylang ylang, clove, lemon, coriander, jasmine, juniper, lavender, tea tree, basil, orchid, anis, rose, rosemary, clary sage were investigated for its antimfungal activity against 4 pathogenic strains: *Aspergillus oryzae*, *A. flavus*, *Alternaria alternata* and *Cladosporium cladosporioides*, which were isolated by sedimentation from the ventilation duct of a residential building and were maintained on sabouraud's dextrose agar slants, which were kept at 10°C and Sub-cultured every 4–5 weeks.

Antifungal activity was evaluated by the degree of inhibition of growth of fungal cultures, comparing the diameter of the experimental and control colonies. Spores were transferred into the Petri dish on sabouraud's dextrose agar slants with a light touch and 0.1 ml [6] of essential oil was applied to the lid of the Petri dish, spread with a sterile spatula over the surface of the lid, and the dishes were placed upside down in a thermostat, the control was paraffin oil. Te diameter of the grown colonies was measured after 3 days and for analysis were used average diameters.

3. Results and Discussion

Immediately, we note that the strain of the fungi *A. alternata*, when growing on a nutrient medium, released pigment into the medium. According to J. C. Frisvald (1988), the release of pigments into the medium can confirm the synthesis of secondary metabolites by micromycetes [7]. It should be noted that the fungicidal effect of essential oils of plants such as coriander, basil, cinnamon, thyme, rosemary, tea tree, cloves, fir, lavender, sage, were previously noted [8]. However, our research allowed us to break down the list of fifteen essential oils into groups with varying degrees of phytoncidal action into four types of molds.

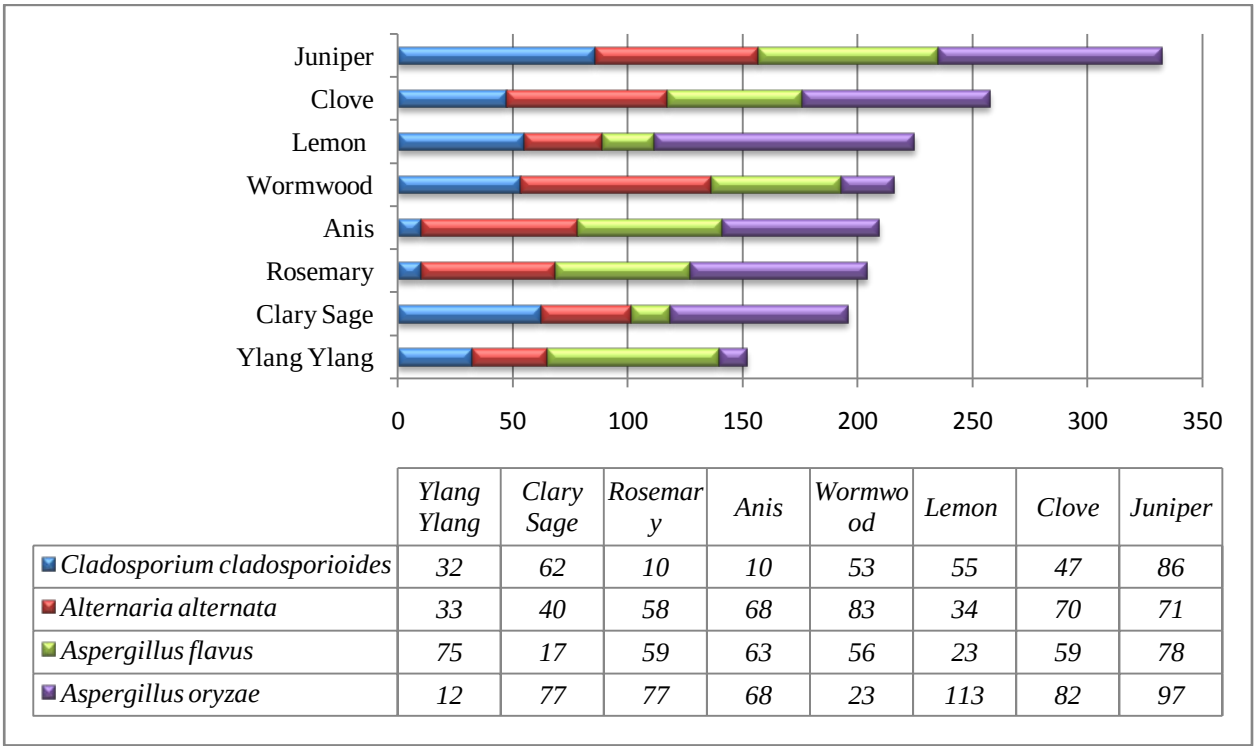
Essential oils of four plants coriander, jasmine, orchid and rose were identified like fungicides to all studied fourth strains, because fungi did not growth with present one of these oils (fig. 1), and these oils can be combined into first group. Lavender oil showed fungistatic properties in relation to *C. cladosporioides* and fungicidal properties in relation to other studied species of fungi. The fungi *C. cladosporioides*, *A. alternata* and *A. flavus* were found to be more sensitive to basil oil, and this oil showed a strong fungistatic effect with respect to *A. oryzae*. Tea tree oil can be attributed to the same, second, group of essential oils, with a significant fungistatic effect on *A. flavus* and a fungicidal effect on other fungi.



	Rose	*Orchid*	*Jasmine*	*Coriander*	*Lavender*	*Basil*	*Tea tree*
Cladosporium cladosporioides	*0*	*0*	*0*	*0*	*17*	*0*	*0*
Alternaria alternata	*0*	*0*	*0*	*0*	*1*	*0*	*0*
Aspergillus flavus	*0*	*0*	*0*	*0*	*0*	*0*	*28*
Aspergillus oryzae	*0*	*0*	*0*	*0*	*0*	*17*	*0*

Figure 1 – The diameter of the colonies of micromycetes (as a percentage of control) in the presence of the first two groups of essential oils

Essential oils of ylang ylang and clary sage can be combined into the third group of fungistatics, with an average total effect, in the presence of which on the covers of the Petri dishes, the size of the mold colonies on the nutrient medium reached from 12 to 77% relative to the size of the control colonies. So, these oils can be invited to group number three (fig.2).



	Ylang Ylang	*Clary Sage*	*Rosemary*	*Anis*	*Wormwood*	*Lemon*	*Clove*	*Juniper*
Cladosporium cladosporioides	*32*	*62*	*10*	*10*	*53*	*55*	*47*	*86*
Alternaria alternata	*33*	*40*	*58*	*68*	*83*	*34*	*70*	*71*
Aspergillus flavus	*75*	*17*	*59*	*63*	*56*	*23*	*59*	*78*
Aspergillus oryzae	*12*	*77*	*77*	*68*	*23*	*113*	*82*	*97*

Figure 2 – Phytoncidal effect of essential oils on the diameter of micromycetes colonies (as a percentage of control)

The influence of the essential oils of the next, fourth, group of plants (rosemary, anis, wormwood, lemon, clove) was noted from strong to weak fungistatic and even stimulating the growth of fungi. So, in the presence of rosemary and anis oils the diameter of the colonies of *C. cladosporioides* did not exceed 10% with respect to the control samples. Juniper oil had a very weak (within the range of the average error) inhibitory effect.

The analysis of the diagram of figure 2, showed that the best phytoncidal fungistatic properties with respect to *C. cladosporioides* were possessed by the essential oils anis and rosemary; against *A. alternata* – ylang ylang and lemon; against *A. flavus* – clary sage and lemon; against *A. oryzae* – wormwood and ylang ylang. It can be assumed that the differences in the antifungal effect of the essential oils of different plants are due to their chemical composition. Moreover, phytoncidal activity is not the same for different types of plants.

4. Conclusion

Thus, it was found that all the studied essential oils have antifungal properties. The group of plants whose essential oils had an absolute phytoncidal effect with respect to *A. alternata*, *A. oryzae*, *A. flavus*, *C. cladosporioides* strains are coriander, jasmine, orchid and rose. Essential oils of lavender, basil and tea tree can also be recommended for the development of disinfectants based on plant components. The oils of rosemary and anis had the greatest fungistatic effect on *C. cladosporioides*. The fungi *A. alternata* and *A. flavus* turned out to be the most sensitive to the components of the lemon essential oil (of all fungistatic oils), which, however, stimulated the growth of colonies of the strain *A. oryzae*, susceptible to oil wormwood.

Conflict of Interest **Конфликт интересов**

None declared. Не указан.

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