ESKİŞEHİR TEKNİK ÜNİVERSİTESİ BİLİM VE TEKNOLOJİ DERGİSİ C- YAŞAM BİLİMLERİ VE BİYOTEKNOLOJİ

Eskişehir Technical University Journal of Science and Technology C- Life Sciences and Biotechnology

2024, 13(1), pp. 18-22, DOI: 10.18036/estubtdc.1282765

RESEARCH ARTICLE

THE MIXTURE OF CARVACROL AND ESSENTIAL OILS FOR ROOM AIR DISINFECTION

Ayşegül HOŞ [1*], Ayşe İNCİ[1], Ozan Emre EYUPOGLU [1], Çağlar MACİT [1], Hasan Hüseyin ÜNAL[2]

[1] School of Pharmacy, İstanbul Medipol University, İstanbul, Türkiye
[2] Pendik Veterinary Control Institute, İstanbul, Türkiye

ABSTRACT

The purpose of this study is to explore the effect of essential oils and carvacrol combination for room air disinfection. Combination of essential oils and carvacrol was homogeneously sprayed to a room containing 44.3 m3 of air. Petri dishes containing Nutrient Agar medium were opened for 60 min in ambient air for sampling from ambient air before and after disinfection at the same four different regions of the room. The incubation was performed at 25 °C for 10 days. After incubation period, the colonies were counted. Microbial load was decreased by essential oils and carvacrol combination approximately 50% for the room air. Essential oils and carvacrol combination may be beneficial in decreasing the microbial load of ambient air. This combination should be a green alternative to chemical disinfectants.

Keywords: Essential oils, Carvacrol, Air Borne Pathogens, Disinfection

1. INTRODUCTION

Ambient air can be composed of large numbers of microbial agents which is called bioaerosols. The risks of epidemics and pandemics increase with airborne transmission of respiratory illness dramatically. Hence, the microbial quality of air is essential [1].

Sick people, an infected/polluted HVAC system, an infected building materials or a terrorist attack may be sources of the floating pathogens in air. There are techniques to keep airborne pathogens away from resident in buildings, or levels low enough not to cause a disease. One of these techniques is using essential oils. Essential oils are used in cosmetics, food, pharmaceutical and beverage industries have strong antimicrobial properties, and they could be applied in the airing industry [2].

Plants have been used in traditional medicine for centuries [3]. Essential oils are the volatile and aromatic products [4] extracted from different plant parts like flowers, herbs, roots, seeds, buds, leaves, twigs, bark, wood, and fruits [5]. Essential oils are the volatile constituent of plants. They usually extracted by steam distillation using a Clevenger type apparatus [6]. Plant essential oils are composed of polar and non-polar natural compounds mixtures. They are well-known for their medicinal feature such as spasmolytic, antiseptic, analgesic, local anesthetic, sedative, anti-inflammatory, anti-carcinogenic [7]. Therefore, the composition and antimicrobial activities of essential oils have been thoroughly and systematically examined in the literature [8].

Plant essential oils have been used for different aims for many years, especially scientific and commercially in many fields. These usages include cosmetics, sanitary, agricultural, pharmaceutical industry, food industry, aromatherapy and phytotherapy [9,10]. In addition to their usage, they can be used as a natural control source like insecticide, fungicide, herbicide and nematocide. It has recently found that they can be used in animal production, poultry, and beekeeping [11].

*Corresponding Author: aysegulhos@gmail.com
Received: 04.05.2023 Published: 30.01.2024

The purpose of this study is to explore the effect of essential oils and carvacrol combination on decreasing microbial load of room ambient air.

2. MATERIALS and METHODS

2.1. Materials

The mixture (combination of essential oils and carvacrol) was purchased from DVL İlaç Sağlık Hiz. ve Gıda Takviyeleri San. ve Dış Tic. Ltd. Şti. The mixture contains oregano oil (*Thymus* sp), carvacrol, aromatic essentials oils of mint (*Mentha piperita*), eucalyptus (*Eucalyptus* sp) lavandula (*Lavandula angustifolia* Miller), clove (*Eugenia caryophyllata*), rosmarinus (*Rosmarinus officinalis*). Nutrient Agar was purchased from Merck.

2.2. Experimental Studies

Combination of essential oils and carvacrol was diluted by distilled water with 1:20 ratio. 20 mL of prepared solution was homogeneously sprayed to a room containing 44.3 m^3 of air to determine the disinfection effect of essential oils and carvacrol combination on ambient air. The room, where the experiments were done, is without air conditioning, without sunlight, at 22 °C and containing 44.3 m^3 of air. After 5 min, petri dishes containing Nutrient Agar medium were opened for 60 min in ambient air at room temperature for the plate method. These four petri dishes were placed at the same four different regions in the room. Then, they were incubated at 25 °C for 10 days. After the incubation period, the colonies were counted. Experimental study was carried out 2 times at 15 days apart.

Spraying of the prepared solution and opening closing of petri dishes procedures were performed by same person wearing facial mask. During the spraying and opening-closing procedures, nobody was not in the room except performer.

As a control, petri dishes containing Nutrient Agar medium were opened for 60 min in ambient air for sampling from ambient air before disinfection at room temperature. This procedure was applied at four different regions in the room. Then, they were incubated at 25 °C for 10 days. After the incubation period, the colonies were counted.

2.3. Statistical Analysis

In statistical analysis, two-way repeated measures ANOVA and non-parametric Mann-Whitney U test was found out as mean ± standard deviation for different comparisons using SPSS version 3.6. software ($p<0.05$).

3. RESULTS and DISCUSSION

When all the literature up to now is reviewed, there have been no studies that show the disinfection effects of combination of essential oils and carvacrol on ambient air except this study. Therefore, this study is the first study investigating room air disinfection by combination of essential oils and carvacrol (oregano oil, carvacrol, aromatic essentials oils of mint, eucalyptus, lavandula, clove, rosmarinus).

This experiment was performed two times. The results of first experiment were given in Table 1. The number of colonies were decreased considerably after disinfection for all regions in the first experiment. The total number of colonies for four regions before disinfection was 71. After disinfection, the total

number of colonies for four regions was 30. The number of microorganisms was decreased approximately 58%.

Table 1. The number of colonies before and after disinfection for the first experiment.

Regions that Nutrient Agar Medium Placed	Number of Colonies Before Disinfection (Control)	Number of Colonies After Disinfection
1.region	22	7
2.region	13	7
3.region	20	7
4.region	16	9

The results of second experiment were given in Table 2. The number of colonies were decreased considerably after disinfection for all regions in the second experiment. The number of colonies for four regions before disinfection was 96. After disinfection, the number of colonies for four regions was 53. The number of microorganisms was decreased approximately 45%.

Table 2. The number of colonies before and after disinfection for the second experiment.

Regions that Nutrient Agar Medium Placed	Number of Colonies Before Disinfection (Control)	Number of Colonies After Disinfection
1.region	32	14
2.region	24	14
3.region	18	12
4.region	22	13

The number of colonies were decreased considerably after disinfection as it can be seen in Figure 1.

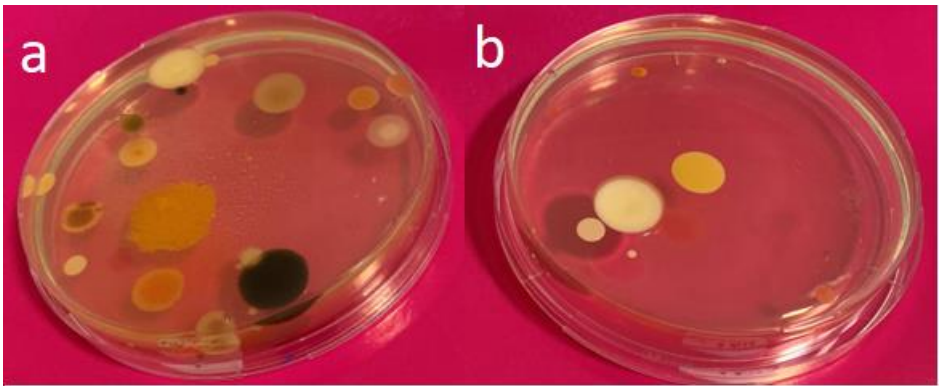

Figure 1. Colonies a) before disinfection, b) after disinfection

Two repeated experiments were analyzed by Mann-Whitney U test. Table 3 was obtained by evaluation of Table 1 and Table 2. It was demonstrated that the reduction in the number of colonies in the first and second regions were statistically significant ($p<0.05$). There were reductions in the third and fourth regions, however these were not significant ($p>0.05$) (Table 3).

Table 3. The statistical results of reduction in the number of colonies before and after disinfection.

Regions that Nutrient Agar Medium Placed	**Number of Colonies Before Disinfection (Control)**	**Number of Colonies After Disinfection**
1.region	27.0±7.1[&]	10.5±4.9[&]
2.region	18.5±7.8[#]	10.5±4.9[#]
3.region	19.0±1.4	9.5±3.5
4.region	19.0±4.2	11.0±2.8

Common disinfectant and cleaning products contain alcohol, chlorine dioxide, organic acids, hydrogen peroxide, iodophor, carboxylic acids, phenolic compounds, ozone, peracetic acid, peroxyacid mixtures, sodium hypochlorite and quaternary ammonium compounds. Some of these agents can lead to the formation of potentially carcinogenic compounds. Unfortunately, potential carcinogenic compounds are still used in laboratory disinfection and/or on food contact surfaces. However antimicrobial products must be efficient against varied pathogens, cannot be toxic to personnel or the environment, must not be potential for antibiotic/biocide cross-resistance, must not interact with matter on surfaces, and/or must not cause harm to the surface. Using essential oils (such as peppermint, oregano**,** cinnamon, and clove) are environmentally friendly and safe for using on various surfaces. Also, the disinfectant properties of natural solutions, which is based essential oil, was mostly equal to potentially carcinogenic compounds or better than them [1].

The microbial load of the room ambient air was decreased by essential oils and carvacrol combination as nearly 50%. So that, this combination can be useful in decreasing the microbial load of air. As a result, it may be a green alternative to chemical disinfectants. Further research is warranted to fulfill the gap in this field to investigate the disinfection effect well.

CONFLICT OF INTEREST

The authors stated that there are no conflicts of interest regarding the publication of this article.

AUTHORSHIP CONTRIBUTIONS

Ayşegül HOŞ: Conceptualization, Investigation, Formal analysis, Visualization, Writing-original draft
Ayşe İNCİ: Conceptualization, Investigation, Visualization, Writing-original draft
Ozan Emre EYUPOGLU: Conceptualization, Formal analysis, Writing-original draft
Çağlar MACİT: Conceptualization, Visualization, Writing-original draft
Hasan Hüseyin ÜNAL: Investigation, Visualization, Writing-original draft

REFERENCES

[1] Sengun IY, Senturk S, Gul S, Kilic G. Potential of essential oil combinations for surface and air disinfection. Letters in Applied Microbiology 2020; 72:526-34.

[2] Bolashikov ZD, Melikov AK. Methods for air cleaning and protection of building occupants from airborne pathogens. Building and Environment 2009; 44:1378-85.

[3] Kürekci C, Sakin F. Essential oils: Essential oils as antimicrobials: In-vitro and in-vivo studies. J Anim Nutr&Nutr Dis-Special Topics 2017; 3(1):15-20.

[4] Bajpai VK, Baek K-H. Biological efficacy and application of essential oils in foods-A review. Journal of Essential Oil-Bearing Plants 2016; 19(1):1-19.

[5] Seow YX, Yeo CR, Chung HL, Yuk H-G. Plant essential oils as active antimicrobial agents. Critical Reviews in Food Science and Nutrition 2014; 54:625-44.

[6] Williams LAD, Porter RB, Junor GO. Biological activities of selected essential oils. Natural Product Communications 2007; 2(12):1295-96.

[7] Nazzaro F, Fratianni F, Coppola R, Feo VD. Essential oils and antifungal activity. Pharmaceuticals 2017; 10(86):1-20.

[8] Kalemba D, Kunicka A. Antibacterial and antifungal properties of essential oils. Current Medicinal Chemistry 2003; 10:813-29.

[9] Çelik E, Çelik GY. Antimicrobial properties of plant essential oils. Orlab On-Line Mikrobiyoloji Dergisi 2007; 5(2):1-6.

[10] Bakkali F, Averbeck S, Averbeck D, Idaomar M. Biological effects of essential oils – A review. Food and Chemical Toxicology 2008; 46:446-75.

[11] Karık Ü, Öztürk M. Current situation of essential oil sector in Turkey, problems and solution recommendations. Alatarım 2010; 9(2):30-37.