

THE ANTIBIOFILM POTENTIAL OF VAPOUR FRACTIONS OF SELECTED ESSENTIAL OILS AGAINST *PSEUDOMONAS AERUGINOSA*



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Background

The biofilm is a major causative factor of chronic, hard-to-heal infections. Due to the biofilm's persistence, even high-dose, systemic antibiotic therapy displays low antimicrobial efficacy [1]. Therefore, there is an urgent need to search for novel bactericidal agents. Essential oils [EOs] are of great interest in this matter because of their broad spectrum of antimicrobial activity and non-specific mechanism of action [2]. Their volatile forms are considered to be more effective than liquids. Since EOs' volatile fractions may be administered locally, the risk of side effects and interaction with other drugs is exiguous. Thus, this form of EOs application may be suitable for the treatment of specific bacterial infections [3].

Materials and Methods

This study aimed to evaluate the antimicrobial activity of vapour fractions of three commercially available essential oils: menthol mint (*Mentha arvensis*, L.), lavender (*Lavandula angustifolia*, Mill.), and eucalyptus (*Eucalyptus globulus*, Labill.) against *Pseudomonas aeruginosa* biofilm. For the research purposes, fourteen clinical multidrug-resistant strains and one reference bacterial strain from American Type Culture Collection (ATCC 15441) were used. The self-developed evaluation method was applied, based on the optimized resazurin staining protocol, to determine the biofilm survival after the exposure to volatile agents [4]. The experiment was performed with six technical replicates. Percentage cells' reduction was calculated by comparison of the biofilm treated with EOs to the biofilm incubated with saline.

Mean Reduction of Cells (%)			
Strain	E-EO	MM-EO	L-EO
PA 1	13.2	26.9	4.5
PA 2	22.3	40.8	2.5
PA 3	3.8	25.9	-0.8
PA 4	6.8	33.6	-6.1
PA 5	18.3	10.0	34.2
PA 6	19.2	53.0	32.7
PA 7	-96.6	5.4	-81.2
PA 13	3.7	17.6	-2.7
PA 14	-8.9	19.7	-4.5
PA 15	-1.2	37.2	-3.8
PA 16	0.0	9.5	1.3
PA 17	13.7	11.2	43.0
PA 18	12.3	15.0	33.0
PA 19	11.9	19.0	40.8
ATCC 14552	-7.5	46.8	-1.7

Table 1. Reduction of biofilm cells (%) of *P. aeruginosa* clinical (PA 1-7, PA 13- 19) and the reference (ATCC 15442) strains after treatment with vapour essential oils. E-EO—eucalyptus oil, MM-EO—menthol mint oil, L-EO—lavender oil. Bolded values indicate five of the highest reductions for each oil.

Results

The results indicate that the EOs' antibiofilm activity depends on the pseudomonal strains' intraspecies variability (Table 1). The lavender oil was active against five clinical strains, with the reduction rate ranging from 33% to 43%. The highest reduction level obtained for eucalyptus oil was approximately 20%. The results for menthol mint oil were differentiated among tested strains and ranged from around 5% to 53%.

Conclusion

The obtained outcomes indicate that tested volatile fractions of EOs possess the potential to be applied in the treatment of infections caused by *Pseudomonas aeruginosa* biofilm. Further research is required to determine if they can be used in monotherapy or as adjuvants of other antimicrobial agents.

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References

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