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# Modulation of Gene Expression by Essential Oils in Bacteria

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**Abstract**

The emerging of drug-resistant strains imposes some new strategies in prevent bacteria spread. It is pivotal to find new candidates for drug development. The essential oils (EOs) extracted from plants are alternatives for it, since they have a variety of cellular target. However, evaluate the efficacy of EOs against bacteria Gram positive and Gram negative, as well as, the toxicity for mammary cell is needed. Here we showed current results the effect of EOs extracted from several plant species on bacterial gene expression.

**Keywords:** Essential oils; Genes expression; Bacteria

## Introduction

Essential oils (EO) are secondary metabolites produced by several plants that act as chemical defences, and can function as antibacterial, antifungal, anti-inflammatory and anticancer [1-4]. The EOs present in some plant families have been showed important activated against microorganisms, such as, to reduce biofilm formation in abiotic surfaces and to inhibit the growth of resistant and multidrug-resistant strains [5-7].

## Discussion

Cinnamon essential oils, contains a very high concentration of cinnamaldehyde. Sheng et al. [8] tested the inhibitory effect of cinnamon oil containing 60% trans-cinnamaldehyde against *Escherichia coli* O157:H7 Shiga toxin (Stx) production. Cinnamon oil significantly reduced Stx2 production and the expression of stx2 gene, and it was confirmed by a Vero cell cytotoxicity assay. Additionally, the expression of qseBC and luxS genes was strongly inhibited, while the expression of oxidative stress response genes (oxyR, soxR, and rpoS) was increased in response to cinnamon oil. Another study showed that *Cinnamomum burmannii* oil inducing the gene expression of icaA in clinical *Streptococcus epidermidis* strains. The oil resulted in an at least a 37-fold increase in icaA gene expression in one strain [9].

Salvia is an important genus widely cultivated and used in flavoring and folk medicines. A repression in tetracycline-resistant tet (K) gene of *S. epidermidis* strain was observed when *Salvia fruticosa* EO and tetracycline were used together [10]. In another study evaluating the potential synergistic of EO from *S. sclarea* and *oxacillin* in the expression of mecA gene in Metilicin Resistent *S. epidermidis* (MRSE) showed that the EO alone inhibited the expression of the resistant genes mecA, mecR1, and mecI and blaZ, blaR1, and blaI. The use of the combination of EO with oxacillin resulted in significantly inhibited expression of mecA gene in all tested strains [11].

*Foeniculum vulgare Mill*. (Fennel) is widely cultivated worldwide. Qiu et al. [12] demonstrate that fennel oil, once used at sub inhibitory concentrations decrease the expression of hla (a-toxin), sea (*Staphylococcal enterotoxins*), tst (toxic shock syndrome toxin 1) and agrA (accessory gene regulator) genes in *Staphylococcus aureus* strain.

Commonly known as Lemongrass, the *Cymbopogon* produce characteristic aromatic essential oils that have pharmaceutical applications as natural source of citral [13]. The expression of the virulence, fatty acid biosynthesis/metabolism and peptidoglycan biosynthesis genes in *Listeria monocytogenes* strains were evaluated were exposed to *Cymbopogon* EO. A down regulation of virulence genes hly and inlJ was observed for all tested strains. An up regulation of acpP and down regulation of plcA, plcB, inlB, inlC and lmo 2470 genes were observed

according to the strain and the transcription of some genes was not affected [14].

*Carum copticum* commonly known as Ajwain, used in India as common spice. The gene expression of Shiga toxins (Stx1 e Stx2) in *E. coli* O157:H7 were tested in presence of *C. copticum* EOs and the results exhibited an increase in gene expression of Shiga toxins in 0.03 % EOs in TSB medium at 35 °C and decrease in 0.5 and 0.75 % EOs in ground beef at 4 °C [15]. Meantime, when the sub inhibitory concentrations of *C. copticum* extract was tested on the expression of tst gene (toxic shock syndrome), hld (virulence gene) in methicillin-resistant *S. aureus* (MRSA) and methicillin-sensitive *S. aureus* (MSSA), the transcription levels of the hld gene were significantly decreased in the MRSA strain and tst gene was inhibited in MSSA strain [16].

Clove essential oil is aromatic and volatile substance extracted from *Syzygium aromaticum* (L.) Merr. & L. M. Perry (commonly known as clove). The clove bud oil in *Pseudomonas aeruginosa* altered the expression of pqsA gene involved in signalling systems, but not in the lasI or rhlI levels, which have been found to control the virulence and biofilm formation [17]. Another study investigating the differential expressions of biofilm-and virulence-related genes in E. coli (EHEC) exposed to clove oil showed a significant inhibited the expression of curli genes (csgA, csgB, csgD, csgF, csgG, fimA, fimC, fimD, fimH, ecpA, ecpR, Z2200) by 8-fold to 155-fold. Likewise, clove oil showed down-regulated several motility genes (swarming genes fimA and fimH and swimming genes flhD, fliA, and motB), and transcriptional regulator ler gene [18].

Baccharis species are shrubs of Asteraceae family, which are recognized as major producers of essential oils with potential biological activity [5]. A study evaluating the effect of *Baccharis psiadioides* EO on gene of L. monocytogenes showed an up regulation of stress genes and down regulation of virulence genes, such as actA, hly and prfA, indicating a decrease in virulence and in the capacity of the microorganism to cause infection [7].

## Conclusion

In conclusion, the use of natural compounds provides a new way for the scientific community to control the expression and growth of microorganisms. Results obtained in the present study on the antimicrobial effect with EOs indicate a down regulation and up regulation of genes, which results in destabilization of bacteria. Therefore, the possibility of reducing its pathogenicity becomes of great relevance for future research.

## Conflict of Interest

Declare if any economic interest or any conflict of interest exists.

## References


1. Pisoschi AM, Pop A, Georgescu C, Turcuş V, Olah NK, et al. (2017) An overview of natural antimicrobials role in food. Eur J Med Chem 143: 922-935.
2. Mendes SJ, Sousa FI, Pereira DM, Ferro TA, Pereira IC, et al. (2016) Cinnamaldehyde modulates LPS-induced systemic inflammatory response syndrome through TRPA1-dependent and independent mechanisms. Int Immunopharmacol 34: 60-70.
3. Yang XQ, Zheng H, Ye Q, Li RY, Chen Y, et al. (2015) Essential oil of cinnamon exerts anticancer activity against head and neck squamous cell carcinoma via attenuating epidermal growth factor receptor-tyrosine kinase. J Buon 20(6): 1518-1525.
4. Ibrahim TA (2012) Chemical composition and biological activity of extracts from Salvia bicolor Desf. growing in Egypt. Molecules 17(10): 11315-11334.
5. Negreiros MO, Pawlowski A, Zini CA, Soares LG, Motta AS, et al. (2016) Antimicrobial and antibiofilm activity of Baccharis psiadioides essential oil against antibiotic-resistant Enterococcus faecalis strains. Pharma Biol 54(12): 3272-3279.
6. Nazzaro F, Fratianni F, Martino L, Coppola R, Feo V, et al. (2013) Effect of Essential Oils on Pathogenic Bacteria. Pharmaceuticals 6(12): 1451-1474.
7. Pieta L, Escudero FLG, Jacobus AP, Cheiran KP, Gross J, et al. (2017) Comparative transcriptomic analysis of Listeria monocytogenes reveals up regulation of stress genes and down regulation of virulence genes in response to essential oil extracted from Baccharis psiadioides. Annals of Microbiology 67(7): 479-490.
8. Sheng L, Rasco B, Zhu MJ (2016) Cinnamon Oil Inhibits Shiga Toxin Type 2 Phage Induction and Shiga Toxin Type 2 Production in Escherichia coli O157:H7. Appl Environ Microbiol 82(22): 6531-6540.
9. Nuryastuti T, Mei V, Busscher HC, Iravati HJ, Aman S, et al. (2009) Effect of cinnamon oil on icaA expression and biofilm formation by Staphylococcus epidermidis. Appl Environ Microbiol 75(21): 6850-6855.
10. Chovanova R, Mezovska J, Vaverkova S, Mikulasova M (2015) The inhibition the tet(K) efflux pump of tetracycline resistant Staphylococcus epidermidis by essential oils from three Salvia species. Lett Appl Microbiol 61(1): 58-62.
11. Chovanová R, Mikulášová M, Vaverková Š (2016) Modulation of mecA gene expression by essential oil from Salvia sclarea and synergism with oxacillin in methicillin resistant Staphylococcus epidermidis carrying different types of Staphylococcal chromosomal cassette mec. Int J Microbiol 2016: 6475837.
12. Qiu J, Li H, Su H, Dong J, Luo M, et al. (2012) Chemical composition of fennel essential oil and its impact on Staphylococcus aureus exotoxin production. World J Microbiol Biotechnol 28(4): 1399-1405.
13. Verma RK, Verma RS, Chauhan, Bisht A (2015) Evaluation of essential oil yield and chemical composition of eight lemongrass (Cymbopogon spp.) cultivars under Himalayan region. Journal of Essential Oil Research 27(3): 197-203.
14. Hadjilouka A, Mavrogiannis G, Mallouchos A, Paramithiotis S, Mataragas M, et al. (2017) Effect of lemongrass essential oil on Listeria monocytogenes gene expression. LWT - Food Science and Technology 77: 510-516.
15. Mahmoudzadeh M, Hosseini H, Nasrollahzadeh J, Khaneghah AM, Rismanchi M, et al. (2016) Antibacterial activity of carum copticum essential oil against Escherichia Coli O157:H7 in Meat: Stx genes expression. Curr Microbiol 73(2): 265-272.
16. Jomehpour N, Eslami G, Khalili MB (2016) The effect of ferula assa-foetida L and Carum copticum hydroalcoholic extract on the expression levels of Staphylococcus aureus genes involved in Quorum Sensing. Jundishapur J Microbiol 9(10): e33879.




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17. Jayalekshmi H, Athira O, Pandurangan N, Vargis VS, Maneesh M, et al. (2016) Clove bud oil reduces kynurenine and inhibits pqs A gene expression in P. aeruginosa. Appl Microbiol Biotechnol 100(8): 3681-3692.

18. Kim Y, Lee J, Gwon G, Kim S, Park JG, et al. (2016) Essential oils and Eugenols inhibit biofilm formation and the virulence of Escherichia coli O157: H7. Sci Rep 6: 36377.


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