Modulation of Gene Expression by Essential Oils in Bacteria

Ana Paula Guedes Frazzon1*, Marcos Saldanha1, Claudio Lauer Junior1,2 and Jeverson Frazzon3

1Department of Microbiology, Immunology and Parasitology, Universidade Federal do Rio Grande do Sul, Brazil
2Feevale University, Brazil
3Department of Food Science, Universidade Federal do Rio Grande do Sul, Brazil

Submission: January 18, 2018; Published: February 06, 2018

*Corresponding author: Ana Paula Guedes Frazzon, Department of Microbiology, Immunology and Parasitology, Federal University of Rio Grande do Sul, Rua Sarmento Leite 500/216, Porto Alegre, Rio Grande do Sul, 90050-170, Brazil, Tel: +55-2151-3308-4505; Email: ana.frazzon@ufrgs.br

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, sotR, 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 Methicillin Resistant S. epidermidis (MRSE) showed that the EO alone inhibited the expression of the resistant genes mecA, mecR1, and mecI and blaZ, blaR1, and blal. 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 EO 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 las or rhl 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 fliH, 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


Your next submission with Juniper Publishers will reach you the below assets
- Quality Editorial service
- Swift Peer Review
- Reprints availability
- E-prints Service
- Manuscript Podcast for convenient understanding
- Global attainment for your research
- Manuscript accessibility in different formats (Pdf, E-pub, Full Text, Audio)
- Unceasing customer service

Track the below URL for one-step submission
https://juniperpublishers.com/online-submission.php