FULL TEXT LINKS

SpringerLink FULL-TEXT ARTICLE

› Appl Microbiol Biotechnol. 2018 Feb;102(4):1955-1967. doi: 10.1007/s00253-018-8736-8. Epub 2018 Jan 22.

Thymoquinone inhibits biofilm formation and has selective antibacterial activity due to ROS generation

Surbhi Goel [1], Prashant Mishra [2]

Affiliations

Affiliations

1 Department of Biochemical Engineering and Biotechnology, Indian Institute of Technology Delhi, Hauz Khas, New Delhi, 110016, India.

2 Department of Biochemical Engineering and Biotechnology, Indian Institute of Technology Delhi, Hauz Khas, New Delhi, 110016, India. pmishra@dbeb.iitd.ac.in.

PMID: 29356869 DOI: 10.1007/s00253-018-8736-8

Abstract

The present study was aimed to investigate the antibacterial potential and antibiofilm activity of thymoquinone and its mechanism of action. Antibacterial activity of thymoquinone was studied using minimum inhibitory concentration, minimum bactericidal concentration, time-kill assay, and post-antibiotic effect. Thymoquinone exhibited antibacterial activity against both Gram-negative and Gram-positive bacteria. In this study, the minimum inhibitory concentration was found to be in the range of 1.56 to 100 μg/ml. Scanning electron microscopy imaging revealed changes in cell morphology with dents, cell lysis, and reduction in cell size. Live/dead imaging using acridine orange and ethidium bromide confirmed the bactericidal activity as treated bacteria showed selective uptake of ethidium bromide over acridine orange. Cell viability was also studied using HaCaT (human keratinocytes) cell line by MTT assay, and IC_{90} value was found to be 50 μg/ml. This IC_{90} value was higher than that of $MIC_{bacteria}$ (except for MIC of E. coli), demonstrating that its selectivity is higher towards bacteria than normal human cells. Thymoquinone also showed promising antibiofilm activity against Gram-negative (E. coli and P. aeruginosa) and Gram-positive bacteria (B. subtilis and S. aureus), which was studied by crystal violet assay, CFU method, and SEM. For understanding the mechanism of action of thymoquinone, DiSC3, NPN, and ROS assay was performed. DiSC3 and NPN assay has not shown any membrane damage whereas bacterial cells treated with thymoquinone at MIC showed increased dichlorofluorescin fluorescence, suggesting that the probable mechanism of action of thymoquinone against bacterial cells is due to the production of reactive oxygen species.

Keywords: Antibacterial; Antibiofilm; Mechanism of action; Reactive oxygen species; Thymoquinone.

Related information

PubChem Compound (MeSH Keyword)

LinkOut – more resources

Full Text Sources

Springer

Other Literature Sources

scite Smart Citations

Medical

MedlinePlus Health Information