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Original Research

Antibacterial Properties of Bacterial Endophytes Isolated from the Medicinal Plant *Origanum heracleoticum* L.

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Abstract

Background: Bacterial endophytic communities associated with medicinal plants synthesize a plethora of bioactive compounds with biological activities. Their easy isolation and growth procedures make bacterial endophytes an untapped source of novel drugs, which might help to face the problem of antimicrobial resistance. This study investigates the antagonistic potential of endophytic bacteria isolated from different compartments of the medicinal plant *O. heracleoticum* against human opportunistic pathogens. **Methods**: A panel of endophytes was employed in cross-streaking tests against multidrug-resistant human pathogens, followed by high-resolution chemical profiling using headspace-gas chromatography/mass spectrometry. **Results**: Endophytic bacteria exhibited the ability to antagonize the growth of opportunistic pathogens belonging to the *Burkholderia cepacia* complex (Bcc). The different inhibition patterns observed were related to their taxonomic attribution at the genus level; most active strains belong to the Gram-positive genera *Bacillus*, *Arthrobacter,* and *Pseudarthrobacter*. Bcc strains of clinical origin were more sensitive than environmental strains. Cross-streaking tests against other 36 human multidrug-resistant pathogens revealed the highest antimicrobial activity towards the Coagulase-negative staphylococci and *Klebsiella pneumoniae* strains. Interestingly, strains of human origin were the most inhibited, in both groups. Concerning the production of volatile organic compounds (VOCs), the strain *Arthrobacter* sp. OHL24 was the best producer of such compounds, while two *Priestia* strains were good ketones producers and so could be considered for further biotechnological applications. **Conclusions**: Overall, this study highlights the diverse antagonistic activities of *O. heracleoticum*-associated endophytes against both Bcc and multidrug-resistant (MDR) human pathogens. These findings hold important implications for investigating bacterial endophytes of medicinal plants as new sources of antimicrobial compounds.

Keywords: endophytes; medicinal plants; volatile organic compounds; antibacterial molecules

1. Introduction

The World Health Organization official definition of traditional medicine is “the sum total of the knowledge, skills, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health, as well as in the prevention, diagnosis, improvement or treatment of physical and mental illnesses” [1]. Medicinal plants have been used since ancient times, and traditional medicine is still practiced in a great portion of the world’s population, especially in developing countries of Africa and Asia, where these practices are perceived as more accessible and affordable, compared to modern medicine [2]. However, it is important to acknowledge that within traditional medicine, certain practices, approaches, or substances have questionable efficacy or were scientifically debunked. Among the different approaches of traditional medicine, phytotherapy has garnered a more extensive body of scientific knowledge. The curative potential of medicinal plants can be attributed to the synthesis of a wide variety of phytochemicals, which have evolved over millions of years; such compounds are involved in the interaction among organisms and in the plant response to different biotic and abiotic stresses [3,4]. Indeed, medicinal plants represent a valuable and manifold source of natural compounds with pharmaceutical potential: in many cases, the isolation and characterization of natural compounds have led to the development of widely used drugs or served as initiating steps in drug discovery [5,6].