PERSPECTIVE

Interactions of different bacterial species with volatiles

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ABSTRACT

An More research is being done on the significance of volatile organic molecules for microbial function. However, because most studies have focused on volatiles produced by monocultures of well-described bacterial genera, little is now known about how inter-specific bacterial interactions influence volatiles production.We wanted to know how inter-specific bacterial interactions impacted the volatiles' composition, generation, and activity in this investigation. Chryseobacterium, Dyella and Janthinobacterium, four phylogenetically distinct bacterial species, were chosen. Previous research had demonstrated that, in contrast to monocultures, pairwise pairings of these bacteria exhibited antibacterial activity in agar media. In the present work, we investigated if the generation of antimicrobial volatiles similarly reflected these observations. As a result, both pairwise combinations and monocultures of the bacteria's volatiles were evaluated for identification and antibacterial activity. The volatiles' antimicrobial efficacy was evaluated using model bacterial, fungal, and oomycete species. Our findings showed that the composition of volatile blends was impacted by interactions between different bacterial species. In contrast, depending on the volatile blend composition, the effect of volatiles on bacteria varied from no effect to growth inhibition to growth encouragement. Fungi and oomycetes have shown considerable sensitivity to bacterial volatiles. A total of 35 volatile compounds were found, the majority of which contained sulphur. Dimethyl disulfide and dimethyl trisulfide, two frequently generated sulfur-containing volatile chemicals, were examined for their impacts on three target microorganisms. Here, we highlight the significance of interactions between different species for the formation of bacterial volatiles and their antibacterial properties.

Key Words: *Monocultures; Chryseobacterium; Janthinobacterium; Tsukamurella; Dimethyl Trisulfide*

INTRODUCTION

An incredible variety of secondary metabolites are produced by soil bacteria. Small molecules from several chemical classes that are gaseous secondary metabolites, sometimes referred to as volatile organic compounds, are able to quickly diffuse and evaporate through pores filled with air and water. Due to their physiochemical characteristics, volatiles are the perfect metabolites for antagonistic interactions and communication amongst soil microorganisms that are geographically separated from one another. Recent research has shown that soil microbes can use volatile molecules as informational chemicals, growth stimulants, growth inhibitors, and quorum-sensing inhibitors. Additionally, volatiles released by rhizosphere bacteria have been shown to stimulate plant development and cause both Induced Systemic Tolerance (IST) and Induced Systemic Resistance (ISR) in plants. Although little is known about how volatiles affect the interactions of soil bacteria that are competitive,

Since these substances have intriguing features that are of considerable interest for agriculture (pathogen suppression), food preparation (aroma), and the cosmetics sector, research on volatiles generated by bacteria has attracted more attention in recent years from a more applied point of view.

Bacterial volatiles can be classified as alkenes, alcohols, ketones, terpenes, benzenoids, pyrazines, acids, and esters, among other chemical classifications. However, cultivation conditions, particularly with regard to the substrate composition of the growth media, may change the mix of exhaled volatiles (volatile blend composition). Additionally, microbial physiological status, oxygen availability, moisture, temperature, and pH are known to have an impact on volatile generation.

The detection of volatile chemicals has improved as a result of recent technical advancements in the field of mass spectrometry. Carter has provided a summary of these developments' specifics. However, the ability to detect and quantify the whole set of released volatiles is the fundamental difficulty in volatolomics. Identification of physiologically relevant volatiles is a demanding and difficult endeavour because the observed volatile blends are typically extremely complicated.

A unique database for microbial VOCs named mVOC1 has, up to this point, documented and described more than 1000 microbial volatiles. However, given the high diversity of bacterial species in soil, this figure appears to be very low, which raises the possibility that the number of microbial volatiles is significantly underestimated.

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Additionally, the majority of investigations on microbial volatile detection have focused on monocultures of bacterial taxa that have already been well documented. As a result, nothing is understood about how inter-specific interactions impact the generation of volatiles. It would be very interesting to learn more about how volatiles are produced in more complex groups because this information could shed light on their ecological significance. Over the past few years, numerous independent investigations have suggested that soil bacteria's ability to produce secondary metabolites can be altered.

Our lab recently conducted a high-throughput screening that showed interactions between soil bacterial species had significant effects in both directions, inducing and suppressing antimicrobial activity.

In this study, we sought to comprehend how bacterial interactions across different species impact volatile emissions and activity. For this, we chose four isolates from four different bacterial species that were part of the sand sedge-associated soil bacterial community. These bacteria displayed increased antibacterial activity during interactions but not in monocultures, according to a previous screening. The current investigation looked into whether volatiles emissions mirrored these observations.