CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Sara D'Souza

Project Number

S1506

Project Title

Analysis of Inter-Kingdom Microbial Interactions Captured by Imaging Mass Spectrometry

Abstract

Objectives/Goals

The purpose of this project is to identify and characterize communication signals in polymicrobial communities using mass spectrometry as a novel tool. Understanding the inter-kingdom communication will help us to study more complex communities such as those living in human bodies which affect our health. Studying how the microbial communities secrete and exchange molecules is invaluable in understanding diseases such as cystic fibrosis, cholera, Crohn#s Disease and can lead to the discovery of novel approaches for antibiotics.

Methods/Materials

Materials: MALDI Matrix,BHI Agar,Tryptone,Yeast,Dextrose,Milk Powder,Bacto-Agar,Xantham Gum,Cheese Curds,MALDI,LTQ-FT,Cheese,MALDI plate,JB182 Bacteria, RS17,RS12,162_3 Fungus
Microbial Growth: Plate Bacteria,Fungus,Bacteria/Fungus,and Bacteria & Fungus on cheese curd agar-allow growth
MALDI Imaging Mass Spectrometry(IMS):Place agar onto MALDI plate with Matrix,dehydrate,analyze MALDI signals
Molecular Networking and Dereplication:Sonicate agar,add various solvents,and collect supernatant.Infuse sample into LTQ-FT Mass Spectrometry.Use Global Natural Products Social Analysis (GNPS) to form Molecular Network and dereplicate by database.

Results

To study interkindgom polymicrobial microbial interactions, bacteria and fungus were grown on agar. Using MALDI Spectrometry, I was able to identify unique organic small molecules secreted by the microbes in proximity and in co-culture. The compounds followed interesting distributions indicating distinct functions and purposes between microbes. To further understand the molecular mechanisms of the interactions, I used molecular networking bioinformatics tools (GNPS) that would aid in finding the identity and structural analogues of the natural products. I then used dereplication tools to find the structures of those molecules compared to millions of known natural products from various databases.

Conclusions/Discussion

Mass Spectrometry is a new platform to understanding polymicrobial interactions. These microbes interact with one another by secreting small molecules. This process and workflow of MALDI Imaging Mass Spectrometry, molecular networking, and dereplication techniques is an effective and efficient system for analyzing the interactions in multispecies communities. In this study, I have found novel compounds that may help us to decode the secrets of microbial interactions.

Summary Statement

In this project, I identified and characterized unique metabolic signals that only occur in inter-kingdom polymicrobial interactions using novel mass spectrometry, molecular networking, and dereplication approaches.

Help Received

Research Work: Professor Pieter Dorrestein's laboratory at UCSD under the supervision of Dr. Laura Sanchez.