Name(s)

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Project Number

S1504

Project Title

Exploring Plant Natural Products for Novel Antimicrobial Activities

Abstract

Objectives

Antibiotics are essential to human health and wellbeing, providing cures to bacterial infections. However, due to a lack of new antibiotics being introduced and the growing threat of bacterial resistance to the currently available antibiotics, the human race is quickly running out of viable options. Therefore it is important to identify new resources for novel antimicrobial activities. The goal of my project is to explore natural plant products for candidates that can be used as antibiotics. In particular, I am interested in the enzyme Plastid Lipase 1 (PLIP1), which is a phospholipase that potentially targets the cell membrane, thereby pointing towards possible antibiotic properties.

Methods

I cloned the gene from the plant Arabidopsis thaliana using Polymerase Chain Reaction (PCR) into a plasmid that replicates in yeast. A secretion signal peptide (Pre-pro-alpha or pre-OST) was fused to the N-terminus of PLIP1 so that the proteins can be secreted out of the yeast cells. Yeast cells expressing and secreting PLIP1 were then examined for inhibitory effect on E. coli growth using two assays. First, yeast cells were spotted on LB plate covered an E. coli "lawn" and the formation of an inhibition zone indicates growth inhibition. Second, supernatant of yeast liquid cell culture were added in LB broth and E. coli cell density was monitored.

Results

I successfully cloned the PLIP1 gene, with two different secretion signal peptides, in yeast. Using the two assays, I was able to show that the yeast cells or supernatants inhibited the growth of E. coli. On the contrary, yeast cells carrying the empty plasmid vector, producing another enzyme, or producing PLIP1 without the secretion signal peptide did not have this antibacterial activity.

Conclusions

My results demonstrate that the natural plant enzyme PLIP1 possesses antibacterial activities, possibly by damaging the cell membrane. The significance of my project lies in that PLIP1 could be used as a novel antibacterial agent with specificity. It also highlights plant natural products as a highly diverse supply for novel antibiotic substances.

Summary Statement

I identified a plant enzyme that has highly specific antibacterial activity, highlighting the potential of novel plant products as antimicrobial substances.

Help Received

I designed and conducted all the experiments myself. Dr. Yanran Li and Ms. Shanhui Xu, University of California Riverside, provided the equipment/reagents and bacterial/yeast strains and plasmids. They also helped with the project through guidance and discussions during the experimental procedure.