Discovery of DNase Effectors as Weapons for Agrobacterium Survival Advantage during Plant Colonization

A research team led by Dr. Erh-Min Lai, an Associate Research Fellow at the Institute of Plant and Microbial Biology, recently reported that *Agrobacterium tumefaciens*, a soil bacterium triggers the growth of tumors in plants, deploys a novel superfamily of type VI DNase effectors (Tde) as weapons for bacterial warfare. During plant host colonization, *Agrobacterium tumefaciens* attacks co-existing competitors via injecting Tde toxins into competitor cells and thereby provides a competitive advantage for Agrobacterium survival inside the plant host. This finding presents a new strategy involved in bacterial competition and suggests potential translational applications in biomedicine and/or agriculture. This work was published online on June 26, 2014 of the scholarly journal *Cell Host & Microbe* and selected as a preview in the July issue.

Since the discovery of the type VI secretion system (T6SS) in 2006, scientists have found that T6SS resembles a needle-like puncturing device and functions to inject effectors/toxins to eukaryotic or prokaryotic target cells for the virulence or survival of many pathogenic bacteria. However, the biological significance and molecular mechanisms underlying this T6SS-mediated bacterial competition in a physiologically relevant environment is largely unexplored.

Agrobacterium tumefaciens is capable of interkingdom DNA transfer to induce plant tumors and serves as a popular gene transfer agent for creating transgenic plants for research and agriculture. Using *Agrobacterium tumefaciens* as a model system, the laboratory of Dr. Erh-Min Lai discovered that Agrobacterium tumefaciens produces a family of type VI DNase effectors (Tde) that are distinct from previously known polymorphic toxins and nucleases. Inside the plant host, *Agrobacterium tumefaciens* activates its T6SS antibacterial activity and attacks co-existing competitors via injecting Tde toxins to degrade the DNA of bacterial competitors. This T6SS-dependent antibacterial weapon supports the survival and fitness of Agrobacterium tumefaciens against competitors including its sibling as well as resilient Pseudomonas aeruginosa during plant colonization.

This finding reveals a new class of T6SS effectors and presents the first report of a role of T6SS effector activity for bacterial competitive advantage at both intra- and inter-species levels inside the plant host. The widespread conservation of the Tde DNase toxin and its associated cognate immunity protein Tdi across bacterial genomes including many plant and animal pathogens implies potential translational applications in biomedicine and/or agriculture. The immunity protein Tdi may be an attractive target for developing new drugs to attack invading bacterial pathogens. In addition, the presence of Tde-Tdi toxin-immunity pairs in several plant growth-promoting rhizobacteria (PGPR) further suggests the dual roles of PGPR in both antibacterial and plant growth-promoting activities.

This work was conducted in collaboration with the laboratory of Professor Alain Filloux, at the MRC Centre for Molecular Bacteriology and Infection at Imperial College London, United Kingdom. The complete article entitled "*Agrobacterium tumefaciens* deploys a superfamily of type VI secretion DNase effectors as weapons for interbacterial competition in planta" can be found at the Cell Host & Microbe journal website at: http://www.cell.com/cell-host-microbe/abstract/S1931-3128(14)00192-9

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