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Bio/Bio News

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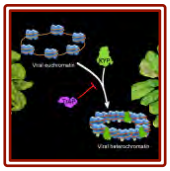
A TrAP for KRYPTONITE

Dr. Xiuren Zhang, Assoc. Professor, Depart. of Biochemistry & Biophysics

Hosts and viruses fight for survival has resulted in a great arsenal of molecular weapons. The host combats DNA viruses by preventing expression of their genomes and by destroying their transcripts. These tactics are known as transcriptional and post-transcriptional gene silencing (TGS and PTGS), respectively. On the other side, surviving viruses must have evolved strategies to subvert the host defense and colonize. The molecular arms race between host and virus, and the effectiveness of their deployment are key determinants of the outcome of the battle.

In a recent publication in *eLife*, the laboratory of Dr. Xiuren Zhang Associate Professor, in the Department of Biochemistry and Biophysics at Texas A&M University, and collaborators from the State Key Laboratory of Plant Genomics and the State Key Laboratory of Rice Biology, reported a new battlefield between plant and virus. They found that the plant host uses a histone methyltransferase, Kryptonite (KYP), to condense the viral genome and prevent infection. Alongside, the virus counters this TGS strategy by expressing the viral protein TrAP, to directly inhibit KYP.



The work of the Zhang Laboratory demonstrates the essential role of KYP as a defense mechanism against the virus, and it is the first evidence of virus interference with an enzyme in the TGS pathway. Opening the doors to biotechnological applications in the development of virus resistant crops and new tools for the manipulation of gene expression. Commentaries on the work can also be found at *eLife* and *Nature Reviews Genetics*.

Biochemistry Recruiting Weekend
February 12- 14, 2016

BACTERIA BATTLE: HOW ONE CHANGES APPEARANCE, MOVES AWAY TO RESIST THE OTHER

From AgriLife Today
December 20, 2015

Two types of bacteria found in the soil have enabled scientists at Texas A&M AgriLife Research to get the dirt on how resistance to antibiotics develops along with a separate survival strategy.

Dr. Paul Straight, Associate Professor, Department of Biochemistry & Biophysics

The study, published in the journal PLoS Genetics this month, identifies an atypical antibiotic molecule and the way in which the resistance to that molecule arises, including the identity of the genes that are responsible, according to Dr. Paul Straight, AgriLife Research biochemist.

Straight and his doctoral student Reed Stubbendieck observed a species of bacteria changing its appearance and moving away from a drug to avoid being killed.

Straight's lab on the Texas A&M University campus in College Station in general focuses on understanding how communities of bacteria interact with each other and other microbes.

Two types of bacteria found in the soil have enabled scientists at Texas A&M AgriLife Research to get the dirt on how resistance to antibiotics develops along with a separate survival strategy.

"Over the past few decades, scientists have come to understand that bacteria aren't just single individual cells that somehow cause infections or degrade toxins, for example," Straight said. "In fact, they are populations and communities of many, many cells, whether just a single species of bacteria or a very diverse community. We are most recently aware of this in terms of the human microbiome. People have more bacteria cells in them than they have human cells."

But what has not been fully understood about bacteria and microbes in general, he said, is the way in which they form these types of communities with more than one species.

"It's both an ecological and a mechanistic bacteriology question," Straight said. "For nearly 100 years, we've known that bacteria can produce molecules that can block the growth of other organisms including other bacteria, and those molecules have been very useful as antibiotics."

Straight said the common understanding of the usefulness of antibiotics, however, sidestepped the ecological dynamics of the bacteria themselves in how they form communities, and interact with each other.

"We wanted to know what happens when we put two bacterial species together to compete with each other and use that model as a way to identify new molecules, identify pathways, or gene functions, that are required for the bacteria to survive under competitive stress," he explained. "Identification of interesting new molecules or bacterial mechanisms of control that one might exploit can lead to developing a new antibiotic."

Reed Stubbendieck, Texas A&M University GENE graduate student. (Texas A&M AgriLife photo by Kathleen Phillips)

For this study, Stubbendieck put together two species of non-pathogenic, soil-borne bacteria, Streptomyces and Bacillus subtilis, in different ways in the laboratory. He monitored the bacteria for different patterns in growth, motility and other factors when the organisms were together as opposed to when they were separate.

Stubbendieck noticed that the two bacteria would grow as expected in each colony initially, but over time one of the bacteria colonies would start to destroy the other one.

"It was very visual," Straight said. "It would cause lysis, meaning that the cells inside the dying colony would be dissolved, leaving a mark of where this had happened."
Stubbendieck had to identify the molecule or other functions that are responsible for causing the destruction, thus the way in which resistance might emerge.

"The molecule turned out to be very strange. It doesn't look like any of the familiar antibiotics," Straight said. "We find it interesting, because its chemical structure suggests it's probably functioning in a way that is very different from the common antibiotics that are used."
https://www.youtube.com/watch?v=qee5CEAIgNA
Stubbendieck also noted that in the region where the cells were destroyed, there developed "little teeny colonies of bacteria" growing, indicating that they're resistant to the molecule. So he picked a number of those colonies and sequenced the genomes, which found the mutations that cause resistance.
"I put a bunch of the cells with mutant bacterial stains on a petri dish together, and when I came in the next morning and looked in the incubator, I saw a difference between the mutants and the non-mutant strain that was night and day, and we knew we are on to something," Stubbendieck recalled.

"With two pieces of the puzzle — the molecule itself identified plus a way in which the resistance to that molecule would arise, including the identity of the genes that are responsible for resistance — Reed was able to dissect the pathway of resistance," Straight said. "And it turns out that in a B. subtilis membrane, proteins work as signaling systems for lots of different things. They can receive signals from the external environment, signals from other bacteria, signals telling them about the status of their cell in a fluctuating environment.

"If something damages a membrane, bacteria have a way of sensing that and then turning on the response," Straight said.
All of the mutations Stubbendieck identified were in the same gene that encodes for a protein in the membrane that functions like a signaling protein, or it has a partner that it talks to, and all mutations turned on the signaling system. And, because the mutants had proteins that were turned on all the time, the drug that previously would have been effective could no longer kill the bacteria.

Additionally, not only did the researchers see that resistance could emerge that way but also the population of the B. subtilis, the one that's typically killed by the drug, changed in appearance.

"It had morphological shapes and structures to it, which suggested that this organism had undergone a really profound change. That allowed it not only to be resistant to this drug, which causes lysis, but also to move as a population of bacteria across the agar surface in a petri dish," Straight said.

"This shows a way that organisms can interact with each other in a competitive, dynamic environment that's very different from the way we typically think about antibiotics," he added. "It is not just a simple, one-way street of a molecule that's produced and causes growth inhibition of the pathogen, and the pathogen can become resistant and that might be a problem for health reasons. What we're seeing here are molecules that can function like an antibiotic and cause something like lysis, or cell death. And the organisms can use not just one resistance function but a combination of responses as a way of circumventing a competitive crisis."

"This helps scientists build a much more mechanistically detailed picture of the competitive dynamics between bacteria, which helps us understand what happens in soil or inside a human intestine," Straight added. "It helps us start to get a better image to work from when we talk about the role of microbes in the environment and the way competitive interactions structure microbial communities; how something becomes resistant and therefore how we might control that."
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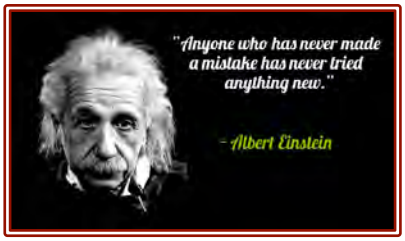

CLAUDIA CASTILLO-GONZÁLEZ RECEIVES VICE CHANCELLOR'S AWARD FOR GRADUATE RESEARCH

Claudia Castillo Gonzales, Biochemistry Grad Student and her PI Dr. Xiuren Zhang

Claudia Marcela Castillo-González, has received a Texas A&M AgriLife Vice Chancellor's Award for Excellence in the Graduate Student Research category, on January 14 during the 2016 Vice Chancellor's Awards in Excellence Ceremony.

Claudia is a Graduate Assistant in Research for the Biochemistry and Biophysics department at Texas A&M University, and is an outstanding citizen of her department. She is generous with her time in helping other students, and is an active leader in the department's Graduate Student Association. Her fellow students view her as outgoing, easy to get along with, and always happy to help.

Claudia's research skills, publication record and supporting letters designate her as a top graduate student. Her research in the lab of Dr. Xiuren Zhang regards the way that plant viruses suppress a plant's natural defense mechanisms.

The results in her publications in the prestigious journal *eLife,* have been recognized as a major step in understanding plant-virus interactions, and could allow for the development of plants that are healthier and more productive.

"Claudia has already demonstrated her exceptional potential in scientific research," said Dr. Xiuren Zhang, Castillo-González's advisor and associate professor of biochemistry and biophysics. "She is clearly a rising, shining star in science."

Castillo-González began her doctoral program at Texas A&M in the fall of 2010 after earning a bachelor's in microbiology and a master's in biological sciences, both from the Universidad de Los Andes in Bogota, Colombia.

The focus of her doctoral program pertains to understanding how a virus can invade a plant and cause disease by suppressing the natural defense mechanisms of the plant. Results from her studies were cited in the nomination as having "far-reaching effects and could allow for the development of plants that are more resistant to viruses, and thus the plants will be healthier and produce better."

She has published results of her research in three professional, peer-reviewed journals, and she has presented her findings at science conferences in the U.S. and Canada. Claudia is also an author on several other recent or upcoming publications.

The Vice Chancellor's Awards in Excellence were established in 1980 to recognize the commitment and outstanding contributions of Texas A&M AgriLife faculty, students and staff statewide

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BIOCHEMISTRY GRAD STUDENT PUBLISHES IN JOURNAL OF BIOLOGICAL CHEMISTRY

Congratulations to Vikas Kumar, a senior Biochemistry Graduate student, in the laboratory of Dr. Jorge Cruz-Reyes, Professor in the Department of Biochemistry, on the submission and publication of his third scientific paper. The title of his new publication, which has been published in the **Journal of Biological Chemistry**: *"REH2C Helicase and GRBC Subcomplexes may Base Pair through mRNA and Small Guide RNA in Kinetoplastid Editosomes"*

Vikas will receive his Ph.D. in Biochemistry this spring (2016), and plans to remain in the Cruz-Reyes lab, as a Postdoc, to complete another scientific paper, that is well under way. Dr. Cruz-Reyes comments, "As a Graduate student, Vikas has always been super motivated about his research."

The abstract is available by clicking on the link for the Epub (ahead of print) website:
http://www.jbc.org/content/early/2016/01/14/jbc.M115.708164 .

Vikas Kumar, Department of Biochemistry & Biophysics, vgehlot@tamu.edu

BGA & STAFF PARTICIPATED IN THE 5TH ANNUAL BCS MARATHON & HALF MARATHON

Congratulations to all the runners who ran in the 5th annual BCS Marathon & Half Marathon, and especially to the members of our department among the thousands participating in the marathon, which was held on December 13, 2015. Things were a bit more interesting for this years participants, than in prior years. Running a marathon requires months of rigorous training, discipline and commitment. However, the runners had not trained to run the half or full marathon in the heavy pouring rain which was falling for the entirety of the run.

The BCS Marathon supports three charities - The Mercy Projects, Voices for Children and Health for All.

Special thanks to all the BGA members who were also out in the cold rain, volunteering and supporting all the marathon runners as well. You guys have a BIG heart!

UPCOMING EVENTS IN BIO/BIO

Bio/Bio Faculty Mtg. 3:30 Rm 127	**Jan. 25**
GENE Recruiting	**Feb. 5-7**
BICH Recruiting Weekend	**Feb. 12-14**
Staff Appreciation Week	**Feb. 29-Mar 5**
Spring Break Fac. & Staff	**March 17-18**
Chili Cookoff/Bake Sale, Mon.	**Feb. 1 5**