UPRM professor receives NSF grant in collaboration with the University of Florida to study venom diversification in spiders from Africa and India

By Idem Osorio-De Jesús
September 19, 2025
PRENSA RUM
idem.osorio@upr.edu

Dr. Timothy J. Colston, associate professor in the Department of Biology at the University of Puerto Rico, Mayagüez Campus (UPRM), has received a $1.2 million grant from the National Science Foundation (NSF) with Dr. Carl Nick Keiser of the University of Florida (UF) as part of a collaborative project in which the two researchers will study how the evolution of social behavior has impacted the diversification of spider venom and microbiome in Africa and India.

As described by the NSF, this work is significant because it integrates tools from evolutionary biology, toxinology, which studies toxic substances produced by living organisms, and microbiome science to investigate how cooperation evolves in nature and whether this evolution is repeatable. It also has practical relevance, as spider venom and its microbes could provide clues for the development of new natural products or medicines, including treatments for chronic pain and infections.

Dr. Colston's lab at UPRM received a $501,107 grant, while his UF colleague, Dr. Keiser, received $698,893 as principal investigators at their respective institutions for the study titled *Social Predators and the Parallel Evolution of Weapon Complexity: Venom Toxins and Microbial Arsenals*. Both researchers will share their discoveries, as well as educational resources to inspire students to apply the scientific method to basic and applied research questions, in Florida and Puerto Rico.

“I am extremely excited and honored by this award. The outcome of this work will no doubt be instrumental to my career, but also to those of my students and collaborators. UPRM students will gain support and training through the grant as well as opportunities for international fieldwork,” said Dr. Colston, who directs the UPRM Genomic Resources Collection.

For his part, Dr. Keiser highlighted that the two scientists became interested in participating in the proposal after meeting at the Society for Integrative and Comparative Biology's annual conference in 2019.

“I am very excited to continue my collaboration with Dr. Colston! We met at a conference in 2019 and developed this project together from the ground up. Our expertise and experiences are distinct but complementary, which makes for the perfect collaboration. We also have similar approaches to mentoring and research integrity so I am confident we will assemble a fantastic team of productive scientists to complete this research at both institutions,” said the UF Biology professor, who specializes in the

ecology of infectious diseases and leads the Behavioral Disease Ecology laboratory at UF.

Both elaborated on the importance of the study they will conduct together over the next three years, a period during which they will benefit from funding allocated by the NSF.

“This grant is an exciting opportunity to explore the interactions of venom diversification, social feeding behavior and host-microbiome dynamics. I don't think any other system has been so uniquely suited to answer these questions,” Dr. Colston emphasized.

Likewise, his UF colleague stated that the research will provide details on how two key evolutionary innovations, venom and sociability, have evolved together.

“Do social predators have more or less complex weapons compared to solitary predators? In addition to these basic science questions, we will study venom toxins and their associated microbes, which could provide a bounty of biological molecules to investigate for potential pharmaceutical applications,” added Dr. Keiser.

In the proposal summary, the NSF highlighted that the project will reveal how venom complexity has evolved in relation to sociality in spiders. This evolution is associated with a redistribution of effort among group-mates to accomplish collective tasks. However, how social groups of predators optimize the distribution of weapons used to subdue their prey is unknown. Venomous predatory spiders represent an effective system to address this knowledge gap, as both social and solitary spiders use venom for defense and prey capture.

The document also states that researchers will explore how venom, a crucial tool for defense and hunting, is shaped not only by the animal's biology but also by the microbes, or microbiome, that inhabit it. They will also study how venom composition, including both toxins and microbial communities, has changed over the multiple independent origins of social living in spiders. By comparing venom traits in social spiders and their solitary relatives, the team will examine whether social living drives changes in venom that help divide labor among individuals.

Dr. Colston, who began his teaching career at UPRM in July 2021, holds a PhD in Biology from the University of Mississippi and conducted postdoctoral research at The George Washington University, Florida State University, and the University of Florida. His laboratory at UPRM specializes in Genomics and Host-Microbiome Interactions in Reptiles and Amphibians.