Researchers find book scorpion venom effective against hospital germs

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The venom of the book scorpion (Chelifer cancroides) contains compounds that could help to combat a dangerous hospital germ in the future. Credit: Louis Roth

The book scorpion (Chelifer cancroides), only a few millimeters long, is the best-known member of the pseudoscorpions, an order of arachnids,

in Central Europe. It hunts house dust mites, bark lice and book lice in living spaces. It also kills pests in beehives. It often uses its venom to do so.

For the first time, researchers in Hesse, Germany, have comprehensively characterized the components of this venom—and discovered molecules with a strong effect against so-called hospital germs. The results may help to combat difficult-to-treat infectious diseases in the future.

Although they represent a diverse group of arachnids with about 3,000 species worldwide, pseudoscorpions—unlike scorpions—are little known and have hardly been investigated as venomous animals. They look similar to their larger relatives with their long claws compared to their bodies, even though their abdomen is not divided or has a venomous sting.

However, their small size, just 1 to 7 millimeters, makes it difficult to analyze their venom, which they inject into their prey through venom glands on their claws.

A team of Hessian researchers from the LOEWE Center for Translational Biodiversity Genomics (LOEWE-TBG) and other institutions has now succeeded for the first time in artificially producing all known members of a family of toxins from the book scorpion (Chelifer cancroides) and investigating their activity.

The scientists discovered a surprisingly strong activity against a well-known hospital germ called methicillin-resistant Staphylococcus aureus (MRSA). Staphylococci are common bacteria that colonize the skin and mucous membranes.

What makes MRSA variants special is that they are resistant to the antibiotic methicillin and therefore cause difficult-to-treat infections in

humans, including after surgery.

The family of toxins analyzed had been newly discovered in a previous study decoding the venom cocktail of the book scorpion and named "checacins." In order to quickly and efficiently find out more about the mode of action of this previously unknown class of toxins, different working groups from the LOEWE Center TBG tested the activity of the toxins against tumor formation, bacteria and inflammation in parallel.

The tests were conducted at the Fraunhofer Institute for Translational Medicine and Pharmacology (ITMP) in Frankfurt, at the Goethe University Frankfurt and at the Fraunhofer Institute for Molecular Biology and Applied Ecology IME, institute branch Bioresources (IME-BR) in Giessen. The study has been published in the journal *iScience*.

Before a pharmacological application is possible, however, there are further hurdles to overcome. "Our data show that the checacins unfortunately also have a certain toxicity for human cells and could possibly cause inflammatory reactions themselves.

"Therefore, we still need to optimize their structure and thus their effect using biotechnological processes, as is the case with other active substances," explains the study's co-first author, Dr. Pelin Erkoc.

Dr. Erkoc is a TBG scientist , who worked at the Institute of Pharmaceutical Biology at Goethe University Frankfurt during the analyses.

"However, the potential of these compounds is already clear. It is predicted that antibiotic-resistant infections could become the leading cause of disease-related death worldwide in the coming decades. It is therefore important to look for new solutions with unusual ideas," adds Dr. Michael Marner, postdoctoral researcher at Fraunhofer IME-BR and

co-author of the study.

"Animal venoms are a veritable treasure trove of potential drug candidates, but only a small proportion have been investigated so far," emphasizes study leader Dr. Tim Lüddecke, head of the junior research group Animal Venomics at Fraunhofer IME-BR and Justus Liebig University Giessen and member of the LOEWE Center TBG.

"In my group, we have developed modern systems biology and biotechnological methods to study the very small venomous animals that are difficult to analyze. In particular, we focus on arachnids. They are the master chemists of venomous animals—Their venoms are particularly complex and pharmacologically promising.

"Our new results on the checacins show how worthwhile it is to take a closer look at the unknown universe of venoms of small creepy-crawlies," Lüddecke concludes.

More information: Pelin Erkoc et al, Determining the pharmacological potential and biological role of linear pseudoscorpion toxins via functional profiling, *iScience* (2024). DOI: 10.1016/j.isci.2024.110209

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