Systematic characterization of the venoms of the 26 medically most important snakes from sub-Saharan Africa

December 13 2022

Mambas are highly venomous members of the Dendroaspis genus. There are four extant species, all of which were included in this study. They are native to different regions in sub-Saharan Africa. Three of these species are green and live primarily in trees. The fourth, the black mamba, is one of the largest and most venomous snakes in Africa. Credit: H. Krisp/Wikimedia Commons

Each year, about 500,000 people in sub-Saharan Africa suffer from snake bites, causing an estimated 7,000 to 20,000 deaths. Many snake species native to the region, such as the feared black mamba, are classified as species of the highest medical importance by the World Health Organization. Using systematic approaches to better understand the composition and function of these snakes' venoms is therefore a medical priority.

The Center for Antibody Technologies headed by Professor Andreas Laustsen-Kiel (Technical University of Denmark) used high-throughput methods to systematically analyze and compare the protein compositions and functions of the venoms of the 26 medically most important snakes in sub-Saharan Africa. This article was published in the journal *GigaScience*.

The snakes investigated in the new study belong to two families, elapids—including, among others, the black and green mambas and the ring-necked spitting cobra, also called the rinkhals—and vipers such as the puff adder and the Gaboon viper.

The composition and function of snake venoms is complex and varies a lot from species to species. The authors describe a general pattern with elapid venoms containing large amounts of a class of proteins called "three finger toxins," which act by blocking neuronal transmission or by killing cells; as well as phospholipases A_2 (PLA_2s), a class of enzymes that is found in many animal venoms.

The viper venoms, on the other hand, are dominated by a different protein mix, including PLA_2s, but also substantial quantities of other enzymes such as Snake Venom Metalloproteinases and Snake Venom Serine Proteinases.

Venom compositions of most of these snakes have been described

before, but the venoms of two species—of Anchieta's cobra (Naja anchietae) and of the white-bellied carpet viper (Echis leucogaster)—are characterized for the first time in the new *GigaScience* study.

The major advance of the work, however, is the parallel processing of samples from 26 snakes in the same high-throughput pipeline; combined with a range of experimental approaches to functionally characterize many venoms in parallel, in a standardized setting.

In contrast, previous studies on the venom compositions of snakes from sub-Sahara Africa have typically been performed in separate studies with only one or a handful of species each, and often with little or no data on functional aspects. The previous studies also used variable protocols, making it difficult to reconcile and compare data from different origins.

The new integrated approach demonstrated in the article, including 26 snake species and a range of functional assays, provides a solid foundation for further studies of snake biology and the development of new antivenoms.

More information: Giang Thi Tuyet Nguyen et al, High-throughput proteomics and in vitro functional characterization of the 26 medically most important elapids and vipers from sub-Saharan Africa, *GigaScience* (2022). DOI: 10.1093/gigascience/giac121

Provided by GigaScience