



## Correspondence



## Obituary: Jesús María Jiménez-Porras (1929–2021)

On January 19th, 2021, Jesús María Jiménez-Porras, a pioneer in the study of snake venoms in Costa Rica, passed away. Jiménez-Porras belonged to one of the first generations of students who graduated from the School of Microbiology at the University of Costa Rica in the decade of 1950. In 1958 he started graduate studies at the Department of Biochemistry at the School of Medicine of Louisiana State University (USA), under the mentorship of Fred G. Brazda and Herbert C. Dessauer, earning a PhD degree. Upon his return to Costa Rica, he was appointed director of the Department of Biochemistry in the newly created School of Medicine at the University of Costa Rica, where he worked for the rest of his career. (see Fig. 1)

In the late 1950s, Herbert Dessauer and others were studying the intra- and inter-specific biochemical geographic variation in reptile species and Jiménez-Porras devoted his doctoral thesis to this subject, focusing on snake venoms. He first published a study on the venom of the Western diamondback rattlesnake, *Crotalus atrox*, quantifying several enzymatic activities in the venom. He also separated venom proteins by using starch gel electrophoresis, at that time a novel technique for analyzing biological samples (Jiménez-Porras, 1961). The separation of venom components was in its initial stages, and new procedures were being developed. For example, the chromatographic media Sephadex®, based on cross-linked dextran beads, had just been introduced in 1959.



Fig. 1. Jesús María Jiménez-Porras in a conference at the School of Medicine, University of Costa Rica, in 1995.

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Jiménez-Porras then studied the venoms of two Costa Rican viperid snake species, i.e., *Bothrops atrox* (now classified as *B. asper*) and *Bothrops nummifer* (now classified as *Atropoides mexicanus*) (Jiménez-Porras, 1964a, 1964b). These were highly innovative projects since he evaluated not only several enzymatic and toxic activities of the venoms, but also introduced the analysis of the geographic, individual, and ontogenetic variation in venom characteristics, a topic that has become relevant over the last decades. In these studies, he quantified various venom activities and carried out fractionation of venoms by starch gel electrophoresis. He sectioned the bands of the gels and tested their activities, hence associating patterns of electrophoretic migration with specific enzymatic actions, and with toxicity in mice. Jiménez-Porras concluded that such variations in venom properties had a genetic basis. At that time there had been few studies on the geographic and individual variation of venoms, such as those done in Brazil by Schenberg, demonstrating geographic variations in the expression of the toxin crotamine in rattlesnakes (Schenberg, 1959). In the case of *B. asper* venom, further proteomic studies corroborated the findings of Jiménez-Porras and explored these phenomena for venom variability in more detail (Alape-Girón et al., 2008).

The observations of Jiménez-Porras demonstrated a clear geographic variation in venom activities and electrophoretic patterns of these two Costa Rican species. Also, he demonstrated individual differences in venoms from the same localities, and ontogenetic variations in the venom of *A. mexicanus*. In 1967 he extended these observations to show striking differences in the venoms of *A. mexicanus* and *A. picadoi*, two snakes with similar morphological features that receive the same common name ('mano de piedra') in Costa Rica (Jiménez-Porras, 1967). More recent proteomic studies confirmed the striking variation in the composition of venoms of these species (Angulo et al., 2008).

These pioneer works paved the way for the study of geographic, individual, and ontogenetic variations of venoms, a subject that has evolutionary, systematic, ecological, and medical implications. In one of his publications, Jiménez-Porras mentioned that such geographic variation in venom composition has implications in the design and efficacy of antivenoms (Jiménez-Porras, 1964a), an issue that is being considered today in the antivenom field. He created a serpentarium at the School of Medicine of the University of Costa Rica and was involved in the first stages of the project that led to the generation of the first antivenoms in Costa Rica.

Jiménez-Porras participated in the first congress of the International Society on Toxinology (IST), held in Atlantic City, New Jersey, in 1966. His study on the venoms of *A. mexicanus* and *A. picadoi* appeared in the book with the proceedings of this meeting (Jiménez-Porras, 1967). In addition to his original research articles, he published two seminal and widely cited reviews on the biochemistry and pharmacology of snake venoms (Jiménez-Porras, 1968, 1970). He was involved in the teaching

of Biochemistry to students of health sciences until his retirement and promoted the creation of the Graduate Program at the University of Costa Rica. Owing to his understanding of snake venoms, he was often consulted by clinicians and other professionals, wrote chapters for medical textbooks, and contributed to the popularization of knowledge on venomous snakes.

Jesús María Jiménez-Porras made outstanding contributions to the discipline of Toxinology and played a key role in research and teaching activities at the School of Medicine of the University of Costa Rica. His legacy is part of the strong tradition developed in Costa Rica in the study of snake venoms.

#### Declaration of competing interest

The author declares that he has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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