

# Morphological characterization of the venom secretory epidermal cells in the stinger of marine and freshwater stingrays

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## Abstract

Marine and freshwater stingrays are characterized by the presence of one to three mineralized serrated stingers on the tail, which are covered by epidermal cells secreting venom. When these animals are dorsally touched, the stinger can be introduced into the aggressor by a whip reflex mechanism of the tail, causing severe mechanical injuries and inoculating the venom. Accidents in humans are frequent causing intense local pain, oedema and erythema. Bacterial secondary infection is also common. In addition, injuries involving freshwater stingrays frequently cause a persistent cutaneous necrosis. The exact localization of the venom secretory epidermal cells in the stinger is controversial, but it is known that it is preferentially located in the ventrolateral grooves. A comparative morphological analysis of the stinger epidermal tissue of different marine and freshwater Brazilian stingray species was carried out. The results indicate that in freshwater species there is a larger number of protein secretory cells, of two different types, spread over the whole stinger epidermis, while in marine species the protein secretory cells are located only around or inside the stinger ventrolateral grooves. These differences between the stingers of the two groups can justify the more severe envenomation accidents with the freshwater species when compared with the marine species.

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## 1. Introduction

Marine stingrays are elasmobranchs found along the Brazilian coast where they are represented by different genera, especially by *Dasyatis*. Besides the marine stingrays, there are three Potamotrygonidae

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genera living in freshwater environment. *Potamotrygon* is well represented in rivers of the North, Central West and Southern Brazilian regions (Rosa, 1985) and, in the last decades, is invading rivers of the Southeast due to hydrographical basin changes caused by the construction of hydroelectric plants (Garrone Neto et al., 2007). Stingrays are characterized by the presence of one to three mineralized stingers (modified barbed spines) in the tail (Fig. 1), which is covered by epidermal cells secreting venom (Halstead, 1970; Charvet-Almeida et al., 2002; Carvalho et al., 2003; Haddad Jr. et al., 2004). The exact localization of this tissue is controversial, but it is known that it is preferentially located in the stinger ventrolateral grooves (Halstead, 1970). Because stingrays are commonly found in the sea or river shores, hidden in the sand, they frequently cause accidents, mainly in the feet and ankles, when people step on them. Hands can also be affected, mainly of fishermen when manipulating fishing nets (Haddad Jr. et al., 2004; Brisset et al., 2006). Accidents are caused by a defensive whip reflex mechanism of the tail in which the stinger is introduced into the aggressor, causing severe mechanical injuries and, at the same time, liberating

the venom (Halstead, 1970; Haddad Jr. et al., 2004). There is no specific serum therapy for these accidents (Haddad Jr. et al., 2004). The patients face intense local pain, oedema and erythema. Bacterial secondary infection is also common. In addition, accidents involving freshwater stingrays frequently cause a persistent cutaneous necrosis (Haddad 2000; Haddad Jr. et al., 2004; Magalhães et al., 2006), which is related to differences observed in the biological activities of the venom of marine and freshwater stingrays (Barbaro et al., 2007). Although the toxinology of stingrays is a relevant subject due to the high frequency of accidents, the literature about the morphology of the venom apparatus of these animals is very scarce (Halstead, 1970; Smith et al., 1974, 1981; Liu et al., 2001).

In this paper, a comparative morphological analysis of the stinger epidermal tissue of Brazilian marine and freshwater stingrays of different species was carried out in an attempt to verify characteristic patterns in the distribution of venom secretory epidermal cells in these two groups. The comparative analysis of the results indicates significant differences between the stingers of marine species and freshwater species of the *Potamotrygon* genus. These differences can justify the more severe envenomation accidents caused by specimens belonging to this genus when compared with accidents caused by the marine species.

## 2. Material and methods

### 2.1. Animals

The stingers were collected from three specimens of each one of the following Brazilian species: *Dasyatis guttata* and *Aetobatus narinari*, from Ubatuba, SP, *Potamotrygon falkneri*, from Três Lagoas, MS, *P. orbignyi*, from Colares, PA, and *P. leopoldi*, from Altamira, PA.

### 2.2. Histology

After collection, the stingers were immediately immersed in Karnovsky fixative (Karnovsky, 1965) and brought to the Laboratory of Cellular Biology of Instituto Butantan. After 48 h in the fixative, they were submitted to decalcification in 4% EDTA. Pieces of three different regions (apical, medial and basal regions) were then dehydrated and embedded

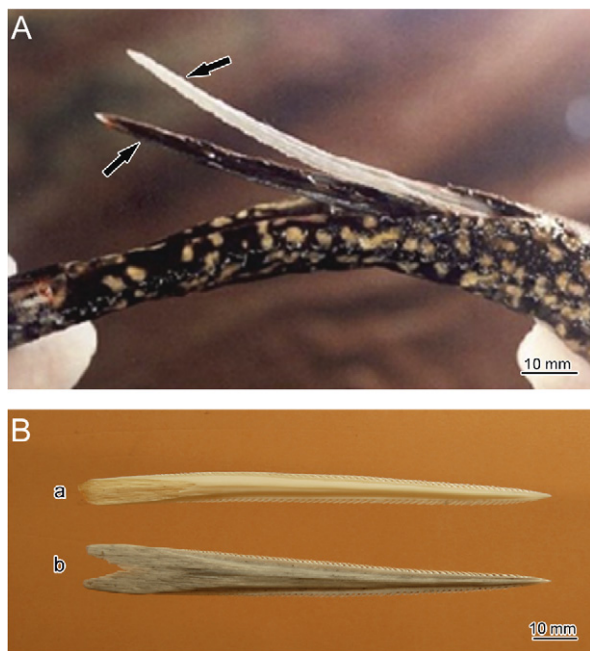


Fig. 1. (A) Tail of *Potamotrygon falkneri* with two stingers (arrows). (B) Mineralized portion of the stingers of *Dasyatis guttata* (a) and *Potamotrygon falkneri* (b). The stingers are flattened dorso-ventrally, with the lateral edges formed by two lines of smaller stingers pointed to the caudal extremity.

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