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A Comparative Microscopic Study on the Ultrastructural Patterns of Shed Snake Skin for Distinguishing Venomous and Non-venomous Snake Species

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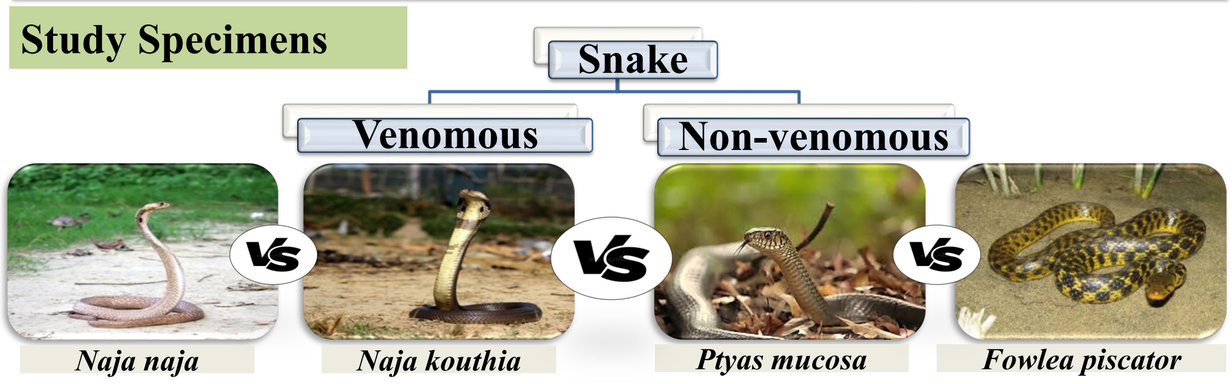
INTRODUCTION & AIM

Snakes are crucial to ecosystems but are often misunderstood, leading to conflicts due to difficulties in identification(Hsiang et al., 2015). With over 3,700 snake species globally, 650 are venomous, and around 250 pose significant health risks(Williams et al., 2019). In Bangladesh, where 70% non-venomous and 30% venomous, are confusion often arises among species(Haider et al., 2023). Misidentification results in unnecessary killings of both venomous and non-venomous snakes. Traditional identification methods are often subjective and unreliable, particularly for closely related species (Jadin et al., 2020). Advances in microscopy have introduced microdermatoglyphic analysis of scales as a promising identification technique (Banzato et al., 2013). This study examines the microscopic ultrastructure of shed snake scales to differentiate venomous from non-venomous species effectively, promoting better conservation strategies and snakebite management in resource-limited settings.

METHOD

Study Specimens



Shed Skin, Scale Sampling & Microscopic observation

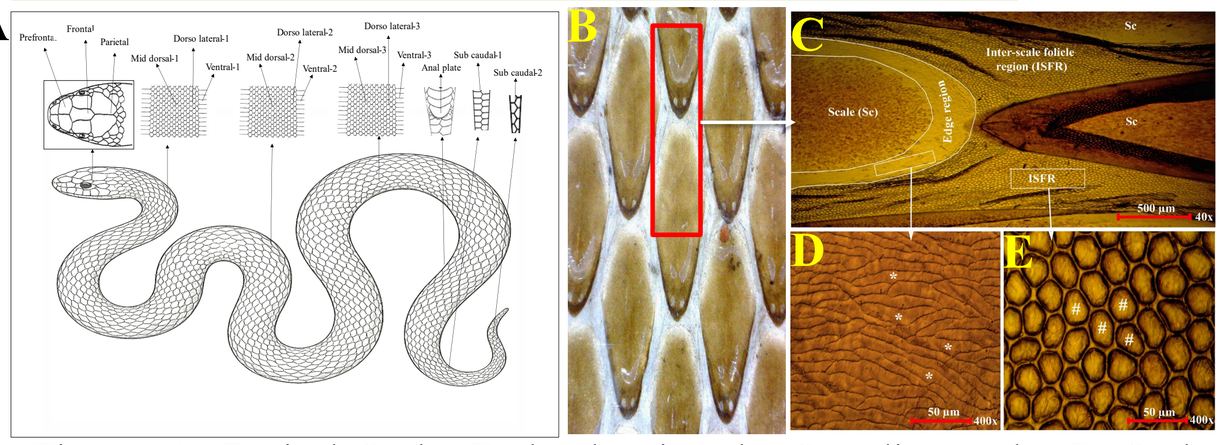


Figure: A. Typical Snake Body showing the Sampling scale; **B.** Snake Scale. **C.** Microscopic picture of the skin showing edge region and inter-scale follicle (ISFR) at 40X; **D.** Microscopic picture of edge region at 400X; and **E.** Inter-scale follicle at 400X

Data collection

Data was collected by using Image Focus Alpha Software and transferred to the excel sheet

Analysis

Morphological Analysis: We visually observed distinct differences in the microdermatoglyphic characters between two non-venomous snakes, two venomous snakes, and between the two categories of snakes.

Statistical Analysis: Morphometric characters were compared:

- Between species and category pairs using paired t-tests or Wilcoxon tests ($p < 0.001$).
- Principal Component Analysis (PCA) was conducted to visualize species-wise and category-wise clustering.

RESULTS & DISCUSSION

Morphological observation

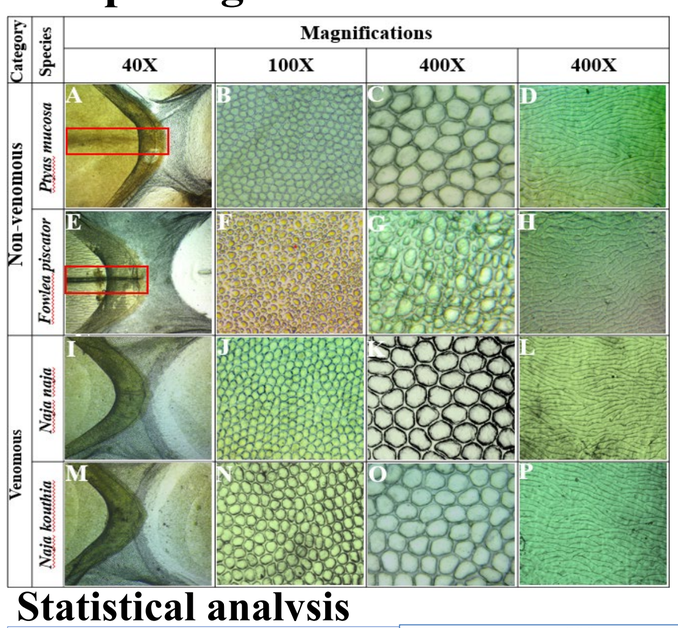


Figure: Microdermatoglyphic structure of shaded scale of snakes at different magnifications. First column, Full scale at 40X magnification. second column, Inter-scale follicle at 100X magnification. Third column Intel Scale follicle at 400X magnification. Fourth Column edge region at 400X magnification.

Statistical analysis

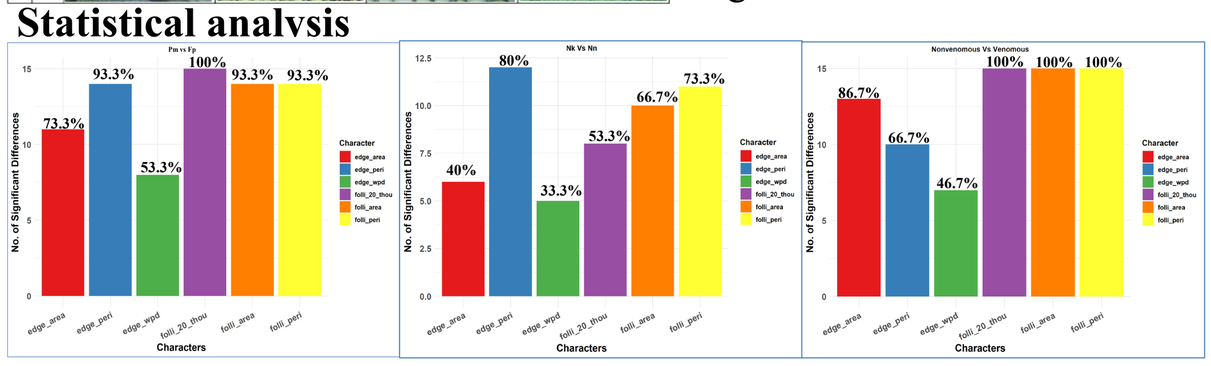


Figure: Statistical analysis of the six characters in microscopic ultrastucture of shed-off skin to differentiate 15 scales of A. *Naja* vs *naja kouthia* B. *Ptyas mucosa* vs *Fowlea piscator*; C. Non-venpmous vs Venomous sanke in pairwise comparison ($p < 0.001$)

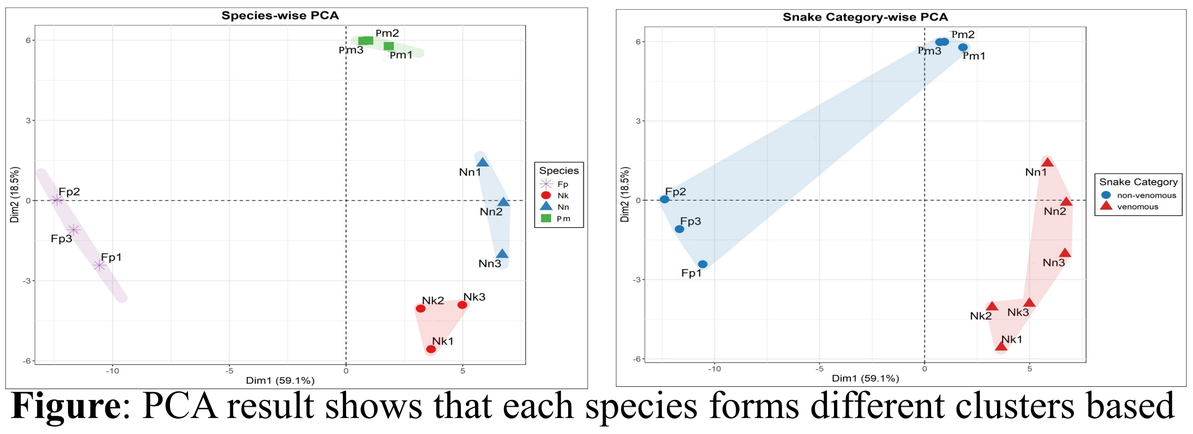


Figure: PCA result shows that each species forms different clusters based on their microdermatoglyphic data (left). On the other hand, category-wise analysis showed that each category formed a different cluster based on its microdermatoglyphic data.

CONCLUSION

This study shows that microdermatoglyphic features in shed snake scales can distinguish venomous from non-venomous species. Statistical analysis revealed significant differences among species. This non-invasive method is valuable for species identification and assessing venom risks, enhancing snake taxonomy and public safety.

FUTURE WORK

- cryptic species can be identified by using this method.
- A morphological data bank can be produced using this method.
- Overcome the limitations of molecular and traditional morphometrics methods

Referencce

Al Haidar, I. K., Ghose, A., Noman, M., Rahman, M. M., Rudra, S., Auawal, A., Islam, M. R., Uddin, M. A., Uddin, R. A. M. E., & Sayeed, A. A. (2023). Implementation of ecological distribution of venomous snakes for clinical management of snakebite in Bangladesh. *Journal of Medicine*, *24*(2), 139–151.

Banzato, T., Hellebuyck, T., Caelenberg, A. Van, Saunders, J. H., & Zotti, A. (2013). A review of diagnostic imaging of snakes and lizards. *Veterinary Record*, *173*(2), 43–49.

Hsiang, A. Y., Field, D. J., Webster, T. H., Behlke, A. D. B., Davis, M. B., Racicot, R. A., & Gauthier, J. A. (2015). The origin of snakes: Revealing the ecology, behavior, and evolutionary history of early snakes using genomics, phenomics, and the fossil record. *BMC Evolutionary Biology*, *15*(1), 1–22. https://doi.org/10.1186/s12862-015-0358-5

Williams, D. J., Faiz, M. A., Abela-Ridder, B., Ainsworth, S., Bulfone, T. C., Nickerson, A. D., Habib, A. G., Junghanss, T., Fan, H. W., & Turner, M. (2019). Strategy for a globally coordinated response to a priority neglected tropical disease: Snakebite envenoming. *PLoS Neglected Tropical Diseases*, *13*(2), e0007059.