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9 August 2005: Amphibian skin chemistry reflects convergent evolution

Similar evolutionary forces have independently honed the chemistry of poisonous frogs on different sides of the world, according to a team of US and Madagascan chemists and biologists. Poisonous frogs from South America and Madagascar, which are only very distantly related, derive similar toxins from their insect diet, the researchers report.

Frogs that secrete toxic chemicals known as alkaloids from their skin as a defence mechanism are found in South America, Australia and Madagascar. Research over the past decade has shown that most South American species of poisonous frog acquire their defensive chemicals from their insect food, especially from certain species of ants. Now, US and Madagascan researchers, led by chemist Valerie Clark from Columbia University, New York, have shown that three poisonous frog species from Madagascar also obtain alkaloids from their diet of ants.

Clark's team used gas chromatography and mass spectrometry to identify the various alkaloids secreted by the three Madagascan frog species, and also looked for alkaloids in samples of insects taken from the Ranomafana National Park in Madagascar. They identified a total of 81 alkaloid compounds in the frog secretions, of which 11 also showed up in the insect samples, mainly produced by one species of ant. The researchers detected seven of these alkaloid compounds in frogs and ants found in close proximity.

The findings, together with the discovery that ants made up the largest proportion (67 per cent) of the contents of the frogs' stomachs, are strong evidence that the Madagascan frogs derive alkaloid compounds primarily from the ants in their diet. These alkaloid compounds are very similar to those produced by South American species of poisonous frogs and ants, even though the species are not closely related. This implies that convergent evolution has led certain ant and frog species in these two different locations to develop the same ability to generate and store alkaloids.

Clark plans to use similar analytical techniques to study other amphibians. 'One project barely begun in this respect is to determine the skin chemistry of the nearly extinct Kihansi spray toad, which is endemic to a gorge in Tanzania,' she told *Chemistry World*. 'We are hoping that we might find alkaloids or bufadienolides (toxic steroids), which would become another example of convergent evolution in the skin chemistry of frogs.' *Jon Evans*

References

V C Clark *et al*, *Proc. Natl. Acad. Sci. USA*, 2005, **102**, 11617