

A snail's sting

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Despite their apparent slothfulness, some snails know how to put a predator on its knees. Intuitively, we are inclined to believe that defence involves not only speed but also liveliness – two qualities which would not be those that spring to mind when describing a snail. So there is more to a snail than meets the eye. Indeed. Though the snails themselves may be the very image of idleness, they can produce molecules which can kill. Fast. This is nothing new. What is new, however, is that scientists have just found a toxin in a snail known as the apple snail, which is not only a protein but is also found in the snail's eggs. So, long before a snail has actually developed into a mature mollusc, it is outfitted with a means of defence.



Snail House

Rory Lane Lutter

This may not sound surprising since snails lay eggs and it would only be natural to provide them with some form of protection. And they do. Once a snail's eggs have been fertilised, they are usually covered in layers of molecules which will not only support the growing embryos but also feed them and protect them. The difference here is that *Pomacea canaliculata* – more commonly known as the golden apple snail because it looks like one – actually provides its eggs with a lethal toxin. Why?

Apple snails are freshwater snails yet they lay their eggs above water level where they are not

only exposed to climatic and mechanical conditions which can be harsh but also to predators. One way of warding off the enemy is by using colours which are far too bright for comfort. Indeed, apple snails lay bright pink eggs that keep most animals at a distance. There are other ways too: such as a bitter taste or a nasty smell. Frequently, an animal – or a plant for that matter – will use more than one way to push away danger. Apple snails use colour but they also use a neurotoxin known as perivitellin-2.

Perivitellin-2 is a large highly-glycosylated protein made up of two subunits. It is synthesized in the snail's albumen gland where it becomes part of the perivitelline fluid surrounding the fertilised eggs. There, it carries out a number of activities – structural, dietary and protective – before it is incorporated and degraded by the embryo during development. How is perivitellin-2 toxic? When injected into mice, the toxin causes them to become weak and lethargic and, in time, paraplegic. Perivitellin-2 seems to act by disrupting calcium regulation within the central nervous system. The disruption of calcium regulation is known to be involved in neuronal degeneration and cell apoptosis, and is at the heart of neurodegenerative diseases such as Parkinson disease and Alzheimer's for example.

Perivitellin-2 though is too large a protein to be transported across the blood-nerve barrier so there is little chance that it acts directly on the

central nervous system. However, either one of its subunits is small enough to cross it. What is more, glycosylation increases permeability and perivitellin-2 is highly glycosylated. So there still remains the possibility that the subunits reach the central nervous system as monomers. This said, there is a fair chance that perivitellin-2 does not act on its own to produce its final toxic effect.

Though the precise action of perivitellin-2 is still largely unknown, coupled with other means of defence developed by *Pomacea canaliculata*, it certainly has proved to be successful. The apple snail has become a real problem in Asia where it attacks rice seedlings and can wipe out whole cultures. The infuriating part for rice farmers is that apple snails do not originate from Asia. They were brought over from South America because they looked nice in aquariums. Always on the lookout for a new source of food,

people started to add them to their own diet and snail-farming was even encouraged on a national scale. But it didn't work out. The snails were not to the taste of many and the farms were abandoned. This spelled heaven for the apple snails who were able to multiply unhindered, and it was not long before they reached – granted: at a snail's pace – rice fields which they demolish unrelentingly.

From South America to Asia, the apple snail has certainly slimed its way across the globe, creating havoc and causing financial disaster for some. Understanding perivitellin-2 in detail may help to develop a pesticide which could be used to check apple snail egg populations in fields which produce a cereal that is so crucial to many. So, while snails have devised a way to protect their progeny by injecting poison into their eggs, it could be that this very poison will be turned against them. It's a tough life.

Cross-references to Swiss-Prot

Perivitellin-2 67 kDa subunit, *Pomacea canaliculata* (Golden apple snail) : P0C8G6

Perivitellin-2 31 kDa subunit, *Pomacea canaliculata* (Golden apple snail) : P0C8G7

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