Secret of worm's poison pill box protein could produce new natural insecticide

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Researchers at the University of Warwick have discovered how a protein from a bacterium acts like a cunningly designed poison pill box that could now be used as a basis of a new range of natural insecticides. It had been known that nematode worms can infect and kill insect pests with the help of a bacterium which they harbour inside their intestine.

The bacterium uses a protein (XptA1) a toxin which helps the nematode to kill and feed on the dead body of the insect. The toxin not only kills the target insect but prevents other predators from eating the body giving free reign to the nematode worms to consume it, multiply and move on. However, until now, researchers had little idea of the make up of XptA1 and thus how it worked.

The research team, based at the University of Warwick's horticultural research arm Warwick HRI, have now been able to reveal the shape of the protein XptA1 and discovered a number of properties that make it a particularly efficient natural insecticide and possible alternative to some commercial insecticides that are facing increased resistance in the insect populations they target.

The researchers at Warwick HRI, together with a team of colleagues with expertise in the Structural Biology group in Biological Sciences and in Chemistry at The University of Warwick, as well as Coventry and Nottingham Universities, found that the protein was formed from four sub units in the shape of a hollow cage or box which is configured to bind well to part of a caterpillar's gut called "Brush Border Membrane

Vesicles" (BBMV).

The XptA1 protein seemed to specifically target the BBMV of caterpillars Pieris Brassicae – (The cabbage white butterfly caterpillar which are pests for many growers). The hollow box structure appears to be a key element of the protein's design. The hollow shape allows the protein to act as a receptacle for two other proteins (in the case of XptA1 these are XptB1 and XptC1). This forms a poison "complex" which makes the XptA1 300 times more toxic to the caterpillars than it would be by itself. As well as helping collect together the three proteins and attach them to the insect's gut the researchers think that the box shape of the XptA1 protein possibly also helps protect the poison complex from the acid attack they would face from the high pH values in the insect gut. The researchers also discovered that, while XptA1 was highly selective in that it bound to the cabbage white butterfly caterpillar, there were variants of this family of toxic proteins (such as XptA2) that targeted other insects.

Dr Sarah Lee from the University of Warwick said: "This research gives us crucial new insights into a family of naturally occurring proteins that are toxic to a number of insect pests. They offer an alternative to current commercial protein based insect toxins have been in use for 40 years and are now starting to meet some resistance. This potential new family of protein based insecticides would overcome such resistance as they operate in an entirely different way."

Source: University of Warwick