Nicotiana alata, the ornamental tobacco plant, has a secret weapon in its flowers: a protein that bursts human cancer cells.

Credit: Flowers in the Wild View full size image

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Scientists at La Trobe University published a study this week about a protein found in the flowers of ornamental tobacco plant that targets human cancer cells and destroys them. This raises the prospect of the deepest kind of irony: tobacco grown to produce drugs used to treat cancers caused by tobacco.

Mark Hulett, Marc Kvansakul and others from the Biochemistry Department used a range of techniques to examine the structure and function of a protein called NaD1. This protein is a type of defensin, a molecule that protects the plant from fungal infections. Why it also works on mammalian cancer cells is unknown, but is probably related to similarities of their cell membranes, where the action in this story takes place.

Of blebbing and lysis

In addition to testing the action of NaD1 against various fungi including yeast, the researchers tested its action on human cell lines known to come from lymphoma, cervical and prostate cancer. The action of interest was the disruption in cell membranes, which was measured in a variety of ways.

The leakage of ATP (a common molecule) was shown to happen within minutes of the introduction of NadD1 to lymphoma cells. Cervical cancers cells showed an increase in the uptake of a dye known as propidium iodide, demonstrating a breach of their cell membranes.

More dramatically, live confocal laser scanning microscopy was used to produce films showing cancer cells change shape in the presence of NaD1. Irregular shaped bulges in cells are known as blebs. Blebbing is like blowing up little balloons on the edges of cells, which often precede cell death. When membranes are broken, the contents of the cell are released in a process known as cell lysis.

NaD1 caused blebbing followed by lysis when introduced to human cancer cells. In other words, they developed bulges and then burst in the presence of this protein. There is unlikely to be a more satisfying experiment than one that results in the explosion of tumour cells.

Ligands in a cationic grip

Using a number of techniques including the X ray crystallography beam at the Synchrotron in Melbourne, they were able to describe the structure of the active component, which only worked when bound to lipids that came from the membrane of the target cell called PIP2. The final NaD1:PIP2 complex contained 14 copies of NAD1 bound to 14 copies of PIP2 in a unique ‘cationic grip’ configuration. The final complex was arch shaped with

unusual fibrillar structures.

PIP2 (also known as phosphatidylinositol 4, 5- bisphpsphate) is an important component of the external structure of the cell, probably involved in cytoskeleton – membrane interactions. It may be that by binding PIP2 molecules the NaD1 protein undermines the external structure of the cell, leading to the aforementioned blebbing and lysis.

One of the ways that the role of PIP2 was confirmed in this process was by testing cervical cancer cells with a mutation that strongly bind PIP2. They took 2.5 times as long to bleb compared to cells that did not hold onto thei PIP2 lipids.

This research, published in eLife, has the potential to lead to new approaches to controlling fungal infections and cancer and certainly provides insight into mechanisms of cell death.

Imagine fields of tobacco grown for their flowers instead of their leaves, leading to an outburst of health consciou tobacco farming. But don't hold your breath, because many years of research will be required before any actual treatment will be available.

On the other hand, I am beginning to feel kindly towards the genus *Nicotiana* (the tobacco plants), which seems tc contain a molecule that bursts cancer cells. It just goes to show you that life is full of surprises.

Susan Lawler does not work for, consult to, own shares in or receive funding from any company or organisation that would benefit from this article, and has no relevant affiliations.

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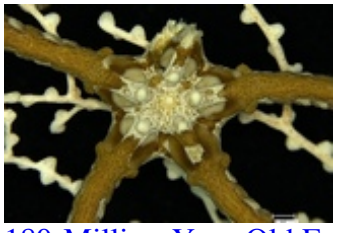

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funny !research,,

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Neat, but it doesn't address whether NaD1 will also cause healthy cells to lyse. There are all kinds of chemical, organic or otherwise that kill cancer, the trick is to only kill cancer. My money is on targeting the mutated stretch of DNA with siRNA that prevents the cancer cells from completing replication.

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An interesting thought, but you would have to know the exact sequence of the mutated region to make a targeted siRNA molecule, and even then, there is a risk of non-specific effects. It's a potentially viable treatment, but it also carries risk of affecting healthy cells.

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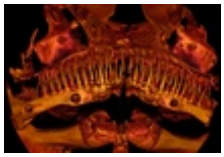

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