The Kiss of Death: Research targets lethal disease spread by insect that bites lips

April 26 2010

(PhysOrg.com) -- It makes your skin crawl -- a bug that crawls onto your lips while you sleep, drawn by the exhaled carbon dioxide, numbs your skin, bites, then gorges on your blood. And if that's not insult enough, it promptly defecates on the wound-and passes on a potentially deadly disease.

Now Jean-Paul Paluzzi, a PhD candidate in biology at the University of Toronto Mississauga, believes that manipulating physiology to prevent the insects from leaving their messy calling card represents the best hope for stopping the transmission of the illness, known as Chagas' disease.

"This is a disease of the poor," says Paluzzi, who has visited parts of the world affected by the illness. "The bugs are found in makeshift homes

with mud walls and palm tree-like ceilings. Unfortunately, the people of Central and South America that this affects don't have sufficient voice to get help. Given that there are roughly 15 to 19 million people that are infected-a substantial proportion of that area's population-it's a disease that's been neglected."

Chagas' disease is one of the major health problems in South and Central America and is spread by reduvid bugs, also known as "kissing bugs" because of their fondness for lips. The disease they transmit is caused by Trypanosoma cruzi, a parasite that lives in their gut. In the initial acute stage, symptoms are relatively mild, but as the disease progresses over several years, serious chronic symptoms can appear, such as heart disease and malformation of the intestines. Without treatment, it can be fatal. Currently, insecticide sprays are used to control insect populations, and anti-parasitic drugs are somewhat successful at treating acute infections. Once the disease is chronic, it cannot be cured.

To make matters worse, kissing bugs are particularly "bloodthirsty". In mosquitoes, which go through four distinct stages of development, only adult females feed on blood (and potentially transmit disease). This means that pest control methods need to target only one out of eight stages (when you include both sexes). But in kissing bugs, each sex feeds on blood through all fives stages of development. "So you have about a ten-fold greater chance of infection just because of the number of times that these insects have to feed," says Paluzzi.

His research focuses on insect diuresis-more specifically, the genes and peptides that control how the kissing bug eliminates excess fluid in its gut after it gorges on blood. For the insect, the real prize in its meal is the red blood cells, while the water and salt is "excess baggage". After they feed, the bugs are bloated and sluggish, and must jettison the waste so they can make their escape.

Here's how it happens: when the kissing bug finds a snoozing victim and feeds, its levels of serotonin and diuretic hormones rise sharply, targeting the insect's midgut and Malpighian tubules (the equivalent of kidneys), and triggering the release of waste. About four hours later, a peptide named CAP2b is released in the insect's gut, abolishing the effect of the diuretic hormones.

Paluzzi has identified two genes (RhoprCAPA-alpha and RhoprCAPA-beta) that carry the chemical recipe for the peptides that stop diuresis. With that information, he hopes to create a peptide "agonist"-something that would enhance the activity of the CAP2B peptide and prevent the insect from leaving waste (and the parasite) on the wound. In theory, says Paluzzi, this might be an insecticide-like room spray or topical lotion that is biologically stable and has no effect on humans or other insects. Paluzzi is collaborating with a structural biochemist at the U.S. Food and Drug Administration in Texas, with the ultimate goal of creating a pest control solution, but he cautions that a market-ready product is many years away.

Provided by University of Toronto Mississauga