



## Sleep Tight and ...

**“We’re dealing with a different bug than what we were [dealing with] decades ago.” – Susan Jones, entomologist**

When I was a kid the nighttime rhyme, “Sleep tight, and don’t let the bed bugs bite”, had no real meaning. I had never seen a bed bug nor knew anyone who had. Nowadays it conjures up frightening and painful first-hand experiences for many who wake up one morning with numerous painful welts.

Bed bugs (*Cimex lectularius*) are 0.5 cm (0.2 in) long, wingless, night-feeding, insect parasites that live exclusively on blood. While they may feed on bats, rabbits and chickens, they much prefer the company, and blood, of humans. We have been living with them for a longtime. Well-preserved bed bug specimens have been recovered from an Egyptian village where workmen lived around 1350 BC. But scientists have speculated that the association first began much earlier when humans lived in caves and the bugs turned to them instead of bats.

Bed bugs are not native to North America, but were carried here by early European colonists. As evidenced by the well-known nursery rhyme, they were an accepted, albeit detested, part of life. The widespread use of DDT (dichloro-diphenyl-trichloroethane) following World War II, virtually eliminated the bug from many countries, but by 1972 DDT use was banned in the US and globally in 2004. However, even earlier, bed bugs began a worldwide resurgence, and cases of infestations are increasingly in the news. The reasons most often cited for their upsurge are increased human (and luggage) travel, exchange of used furniture and a shift from broad-spectrum, longer-lasting pesticides to more selective agents that are rapidly degraded\*.

Pesticide resistance has also been implicated in the bug’s resurgence. For example, in 2008 researchers found that bed bugs collected in New York City are over 200-times more resistant to deltamethrin, than those from Florida. Deltamethrin is a widely used synthetic pyrethroid, commonly found in household insect sprays, that poisons the nervous system by blocking the nerve cell pores that conduct the nervous impulse. The bug’s resistance was found to stem from a nerve cell mutation that makes the pores impervious to the insecticide.



Now a study, published in the January 19, 2011 issue of the online journal *PLoS ONE* ([www.plosone.org](http://www.plosone.org)), by a team from The Ohio State University, Wooster, OH, shows that

modern, urban bed bugs are difficult to kill because they have undergone profound genetic changes, which make them resistant to commonly used pesticides. The researchers used a rapid, state-of-the-art DNA sequencing method to catalogue the bug's genome. They also looked at the expression of genes known to be involved in insecticide resistance. They compared gene activity from bed bugs taken from a recent infestation in a Columbus, Ohio apartment complex with those from a colony of pesticide-susceptible bed bugs kept in a laboratory free of pesticide exposure for 40 years.



The team focused on two genes known to produce enzymes that degrade chemical toxins. By measuring their activity they found that a gene producing a detoxifying enzyme, cytochrome P450, was over 50-times more active in the urban bed bugs than in the laboratory bugs. This class of enzymes is ubiquitous to life and is commonly found at high levels in insects resistant to pesticides. Another gene, which produces the toxin-degrading enzyme glutathione S-transferase, was found to be more active in the early developmental stages of the urban bed bugs. The urban bed bugs had undergone mutations in genes that make them harder to get rid of. “This is the first study to elucidate the genetic make up of the insect and to obtain fundamental molecular knowledge regarding potential defense pathways and genes that may be involved in metabolic resistance to commonly used pesticides”, said Omprakash Mittapalli, Assistant Professor of entomology at The Ohio State University and one of the study's authors.

The hope is that by understanding bed bug resistance at the genetic level, scientists can develop new control methods that are more effective. But right now the only good news in this story is that, to date, bed bugs are not known to transmit any human diseases.

Meanwhile, “Don't let the bed bugs bite”.

Saul Scheinbach

\*For ways to combat bed bugs see: [www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7454.html](http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7454.html).