# Iron Metabolism in Humans and Insects

*Implications for human health and for insect control*

*by Susan McGinley*

*Tobaccco hornworm,* Manduca sexta, *is a major crop pest.*

**Joy Winzerling**
(520)626-2285
**jwinzerl@ag.arizona.edu**

Iron availability affects a wide range of biological processes in humans and other species. It is required for the health of premature infants. It also is implicated in lung diseases that can follow smoke exposure and in the way a mosquito uses a blood meal. A cross-disciplinary team of scientists and students in the Department of Nutritional Sciences at the University of Arizona is studying these problems and others to understand more about iron metabolism in humans and insects.

"There is a well-defined pathway in humans for iron uptake and storage by cells," says Joy Winzerling, a clinical dietitian and assistant professor who directs the program. "We've used that pathway to look at iron metabolism in other organisms. We are looking for iron-binding proteins in insects that are similar to those found in mammals, and they do have them, but it looks like they might function in different ways."

## INSECT RESEARCH

*Aedes adgypti* is a mosquito native to the Southwest that can transmit the viruses for either dengue or yellow fever to the human host during blood feeding, according to Winzerling. "When a female mosquito takes a blood meal it gets a high load of iron," she says. "We want to know how it adapts to that iron load."

With funding from the NIH, Winzerling and her lab are working on a five-year study with UA chemist Ann Walker, Stanford University synchrontron laboratory scientist Graham George, and Daphne Pham of the University of Wisconsin to study the way *A. aegypti* adapts to the iron load of blood feeding. This work could also apply to *A. gambiae*, the mosquito that carries malaria. "Understanding iron metabolism in blood-feeding insects that act as disease vectors could suggest new strategies for vector or infectious agent control," she explains.

In another insect study funded by the USDA, Winzerling and her lab team are investigating iron uptake in *Manduca sexta*, the tobacco hornworm, a major crop pest. In characterizing the iron pathway in this insect, Winzerling hopes to apply some of the information to solving the puzzle in mosquitoes as well. "If our studies are fruitful, they will provide basic information on iron metabolism in insects and potential opportunities for the development of insect control strategies in crops."

## HUMAN INFANTS

Premature infants often do not have sufficient blood cells to meet their needs, so they are given transfusions. They can also receive erythropoietin, or EPO, a protein that stimulates red blood cell formation. Iron is required for red blood cell formation and premature infants have low iron stores. Winzerling and her team are collaborating with Dr. Pam Kling at the University of Arizona Medical Center's Department of Pediatrics to study the effects of transfusion on oxidative metabolism and iron metabolism in premature babies as well as in rat pups, a good model of iron metabolism in the developing infant.

"It's entirely possible that the act of transfusing could suppress the function of the iron pathway in some tissues in favor of red blood cell formation," Winzerling says. "We're looking at the recovery time for the pathway that allows iron uptake into cells to help find the best course of treatment with EPO and iron supplements. There is also a possibility that transfusion could create oxidative products that might require an increase in anti-oxidants to benefit the baby." The work combines Kling's neonatal and clinical laboratory expertise with Winzerling's basic research expertise. "This is a long-term project that could have substantial impact in the treatment of premature infants."

## HUMAN LUNGS

The lung fluids of smokers with tumors contain more ferritin, an iron storage protein, and iron than normal. Winzerling's group is studying iron toxicity from smoke exposure in lung cells. "There is a potential relationship between iron from smoke and lung disease," she says. "We're using cDNA arrays to evaluate the effect of iron on cell growth and death. As with many nutrients, a little iron is good, more is not necessarily better." ❖