Real-time gene monitoring developed

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Imagine having GeneVision: the uncanny ability to view the activity of any chosen gene in real time through a specially modified camera.

With GeneVision, military commanders could compare gene expression in victorious and defeated troops. Retailers could track genes related to craving as shoppers moved about a store. "The Bachelor" would enjoy yet one more secret advantage over his love-struck dates.

Frightening? Perhaps. Ethically suspect? Certainly. Preposterous? Not quite.

A new study in *BMC Biotechnology* correlates real-time gene expression with movement and behavior for the first time. The proof-of-concept experiment in fruit flies opens a new door for the study of genes' influence on behavior.

The authors, from the University of Southern California and Cambridge University, tagged genes with a harmless molecule known as Green Fluorescent Protein (GFP).

When a gene was active, the flies gave off a fluorescent glow. A camera fitted with a special filter detected the glow, whose intensity was then measured automatically.

At the same time, a multiple-camera system designed by first author and USC graduate student Dhruv Grover tracked the movement of each fly in three dimensions.

The result: an exact picture of gene activity at every point and time of a fly's life.

"We can correlate behavior with certain genes and find genes that may be responsible for certain behaviors," Grover said.

The 3-D tracking and real-time measurement of gene activity are both firsts in live animal studies, the researchers said.

The methods also delivered new insights on aging in the fruit fly, long a model organism for the study of biological processes.

The levels of two genes, hsp70 and hsp22, spiked in the hours before the death of a fly.

The genes are known to respond to oxidative stress. Lead author John Tower, associate professor of molecular and computational biology at USC, speculated that the genes were reacting to a sharp increase in oxidative stress as the fly began dying of natural causes.

"We're really interested in why the fly is dying, and this is potentially a good inroad to being able to study that," he said.

Oxidation – the chemical process behind rust and food spoilage – takes place constantly in the body as a byproduct of metabolism.

"Burning that fuel to produce energy is toxic," Tower said.

The real-time methods developed by Tower's group painted the poignant picture, even if only for flies, of an animal's last attempt to fight off death.

Other animals soon will be studied the same way, Grover predicted.

"The beauty of it is now, if GFP can be linked to any gene … you could track it over time, and you could look at the expression of that gene. It's much easier than looking at it through the microscope, having a grad student sit there and take pictures every few hours and look at the (gene) expression change. This is just running on its own," he said.

It was Grover's thesis adviser Simon Tavare, a professor of molecular and computational biology at USC and faculty member at Cambridge, who suggested how to track flies in three dimensions.

"After that we started to think about, 'Can we look at the expression of certain genes over time, as they're moving?' " Grover recalled.

"That would be really interesting."

Even more interesting, for everyday life, would be a mosquito zapper guided by the tracking system – an application that Grover and Tower say just might be feasible.

Read the study at www.biomedcentral.com/1472-6750/8/93/abstract

Source: University of Southern California