DNA Chips Boost Dairy Research

Gene microarrays target heat stress in cows

by Susan McGinley

Arizona's cattle endure intense solar radiation and thus heat stress, which lowers milk production. A University of Arizona program underway in the Department of Animal Sciences uses DNA microarrays to identify genes related to susceptibility as well as resistance to heat stress in cattle. The genes in this library, numbering in the thousands, will then serve as markers for selecting animals that can thrive in central and southern Arizona's desert climate.

"As productivity of domestic animals increases, their heat production also increases, making them more susceptible to thermal stress," says Robert Collier, an environmental physiologist in charge of the program. "We're looking at genes associated with production traits such as milk production, reproduction and growth, as well as resistance to thermal stress." The study emphasizes both gene function and physical factors in a production environment.

Collier is working with Holstein and Brown Swiss cows at the Campus Agricultural Center in Tucson. Within the next year, the College of Agriculture and Life Sciences will construct the Agricultural Research Complex (ARC).

"This building will mimic conditions outdoors," Collier says. "It will have special light panels that can change in intensity, plus temperature controls so we can develop new ways to determine each cow's internal heat stress. The animals will undergo short-term testing, and will not be exposed to any conditions they don't normally endure in the natural environment."

For the gene expression work, Collier and his team, which includes two laboratory staff members, one postdoctoral associate and three graduate students, are constructing microarrays using genes from the tissues of UA cows processed through the campus packing plant.

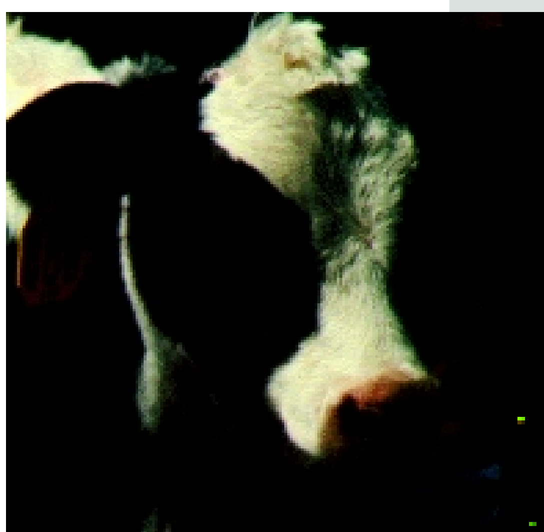
"A DNA microarray is a glass slide—"chip"—with all of the genes in the database arrayed across its surface," Collier explains. "It permits us to evaluate 10,000 genes simultaneously, so we can find out what is changing as animals adapt to heat stress."

Collier's lab group is assembling a collection of genes that includes DNA microarrays developed on campus and from other sources, including a 10,000-clone database from Monsanto, and a 5,000-gene microarray of cattle skin genes from a group they are collaborating with in Australia. That database will be used to determine the effect of external heat stress on cows at the UA and will identify which genes should be included in the "bovine chip."

After the microchips are constructed, the researchers will take blood and tissue samples from cattle, screen them against the microarrays, and measure the activity of particular genes in each animal. Certain genes will then be used as selection markers to assist in choosing cows with the most appropriate characteristics.

"Once the platform is built, we want to make sure it has broad applications," Collier says. "Animal sciences faculty will look at these genes in their breeding schemes to see if they are useful markers or not. Other scientists will be able to use the microarrays in this database not just for thermal aspects, but for any studies related to production in sheep, horses, and other domestic species."

Collier hopes his research will assist in identifying superior animals as well as the in the development of better facilities that protect dairy cows from the hot, arid conditions they endure in Arizona. As the cows produce more milk under less stress, production costs will decrease and the cows will remain healthier. ❖



What is a Gene Microarray?

Molecular biologists are used to performing experiments using one gene at a time. With DNA microarrays (also known as gene arrays, gene chips, DNA chips and genome chips), scientists can evaluate thousands of genes simultaneously.This greatly speeds analysis and interpretation, allowing researchers to "see the big picture" much faster.

This exciting new tool consists of thousands of DNA samples arrayed in rows of orderly dots bonded to a specially prepared glass microscope slide. Genes can be placed on the chip by hand, but are now more commonly applied through high-speed robotics.

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DNA dots on glass gene chips