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**United States Department of Agriculture**

Cooperative State Research, Education, and Extension Service

Initiative for Future Agricultural Food Systems (IFAFS)

# Chicken Genome Leads to New Vaccine to Fight Poultry Disease

*by Stacy Kish, CSREES*

Researchers in Michigan, Delaware and Texas are using the chicken genome sequence to develop vaccines to combat Marek's disease, a highly contagious, cancer-causing viral disease which costs the poultry industry $1 billion a year worldwide. USDA's Cooperative State Research, Education, and Extension Service (CSREES) provided funding for this project. >>

Jerry Dodgson and colleagues at Michigan State University, the USDA–Agricultural Research Service Avian Disease and Oncology Lab, the University of Delaware and Texas A&M University began by assembling the physical map of the chicken genome using DNA clones that describe all or nearly all of the genes in the chicken. The researchers then began to identify individual genes whose levels went up or down after infection by Marek's disease virus (MDV). To do so, they used a 'gene chip' with approximately 13,000 gene sequences (about half the chicken genes) to assay levels of gene products before and after MDV infection, and in chicken lines that were highly susceptible versus lines that were more resistant.

In the field, MDV spreads from bird to bird via inhaled feather dander. So, any infected tissue is a mixture of uninfected and infected cells that are closely intermingled, making it difficult to distinguish differences between them.

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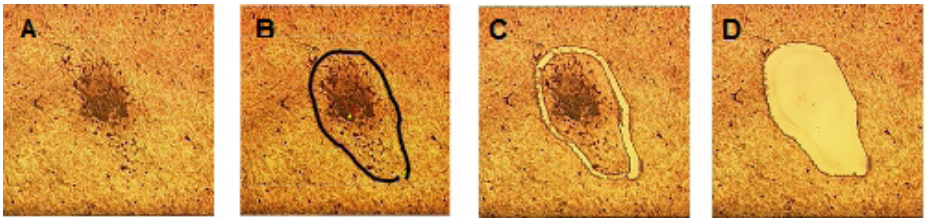
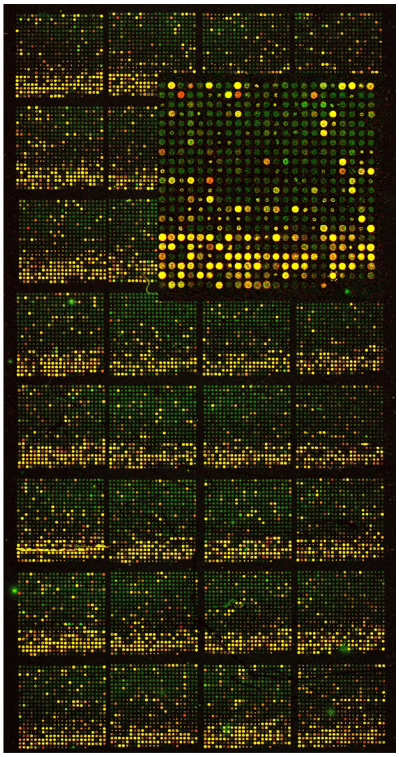
**Right:** Image of a jungle fowl used in the study.

*Credit: Jerry Dodgeson*




**Right:** Separation of MDV-infected chicken embryo fibroblasts (plaques) by laser capture microdissection: A) MDV plaque; B) outline of area to be cut: C) area cut by laser; D) cut area after capture of cells; magnification 20X. Adjacent cells were excised from area surrounding plaque.

*Credit: Jerry Dodgeson*



**Above:** Using an international collection of chicken gene sequences, a microarray was produced that contains sequences from 13,000 genes expressed in 24 different adult and embryonic tissues. The array is used to compare the activity of genes in two tissues or conditions (e.g., before and after MDV infection). Higher activity in the first tissue or condition is indicated by a red spot, whereas higher in the second would be green. A yellow spot is equal activity in both conditions. The color intensity or brightness is an indication of the total activity. Inset is enlargement of second block, top row.

*Credit: Jerry Dodgeson*

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Using a laser to micro-dissect a clump of infected cells from uninfected ones, the group discovered a suite of genes in the chicken genome that influence the course of viral infection. This new understanding of the interaction between the virus and the genes was used to develop new ways to identify genes in the chicken that are turned on or modified by MDV infection.

Through this research, a new recombinant vaccine was developed by cloning one of the identified genes, called chicken MIP-1, into the vaccine strain of the virus. The protection this vaccine provides is comparable to that afforded by the best commercially available vaccines.

The chicken genome sequence developed during this project is now available to scientists working on MDV worldwide. The data generated by this project are also available on two Web sites: http://poultry.mph.msu.edu and http://www.chickest.udel.edu, to provide other scientists instantaneous access to the data prior to publication.

The genome sequence opened the door to recent, detailed analyses of genetic variation in and between commercial chicken lines. Breeders are using this information to produce a more resistant chicken line. Future work on this topic will explore new approaches, such as gene silencing or RNA interference, to enhance the effectiveness of new vaccines. The project will also explore the use of genetic markers to improve resistance to Marek's disease in commercial flocks.

CSREES funded this research project through the Initiative for Future Agricultural and Food Systems (IFAFS) program. CSREES advances knowledge for agriculture, the environment, human health and well-being, and communities by supporting research, education and extension programs in the Land-Grant University System and other partner organizations. For more information, visit www.csrees.usda.gov. ■

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