Understanding the Genetics of Immunity and Resistance to Avian Diseases

Poultry consumption has increased steadily since 1960. Demand is expected to keep growing, but avian diseases pose a major challenge to poultry production. Each year, diseases cause serious economic losses, and preventative measures and treatments are costly. Avian diseases can also pose a health threat to other animals, including humans. At the same time, there is demand to produce poultry without antibiotics or other drugs commonly used to fight diseases.

Working together on a Multistate Research Project, scientists at land-grant universities are shedding light on poultry genetics; identifying ways to improve poultry immunity and resistance to disease; and sharing findings, tools, and methods with producers, breeders, vaccine developers, veterinarians, and others.

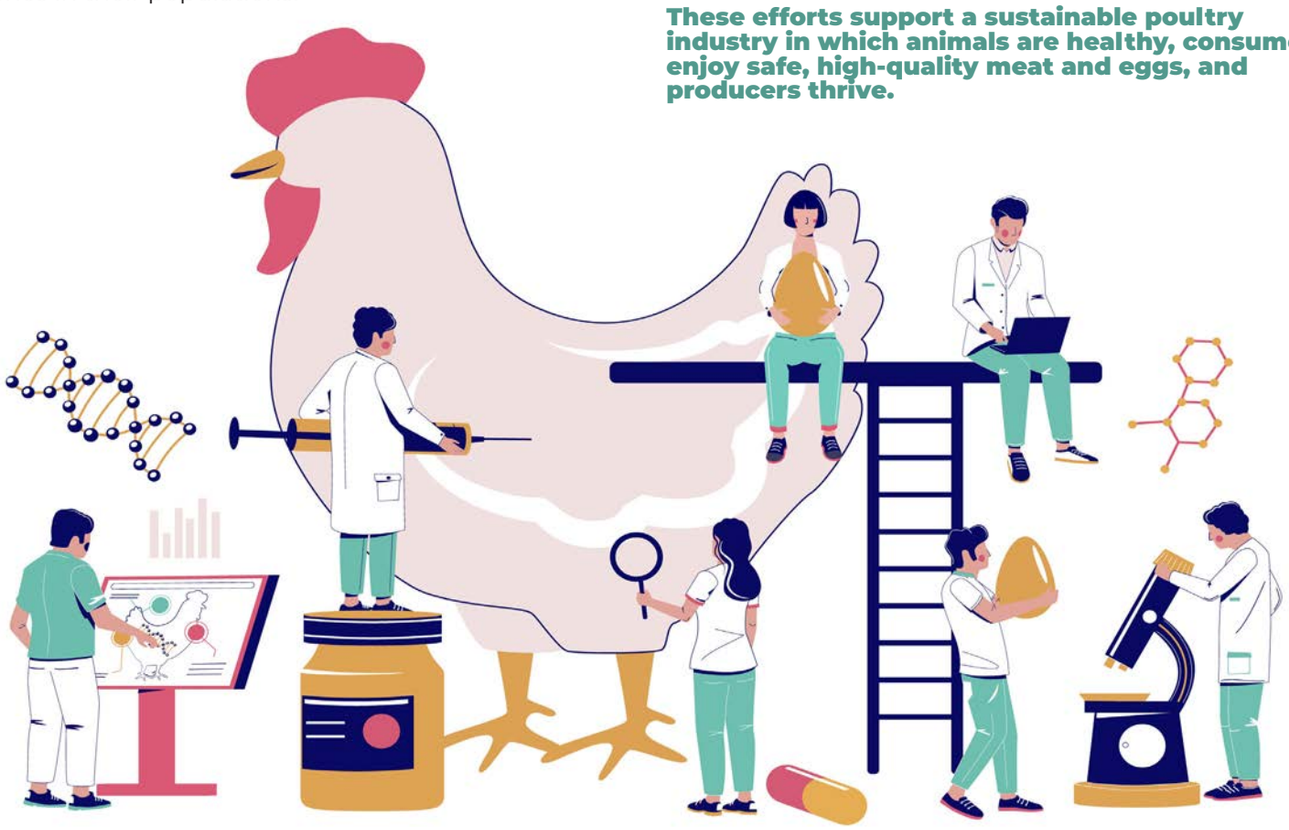
The multistate approach is key.

No single state or institution has the range of expertise, facilities, equipment, and biological resources (like specialized genetic stocks, antibodies, and pathogen stocks) needed for avian disease research. The multistate approach brings together researchers from different disciplines and states, enabling efficient resource sharing, facilitating long-term collaboration, and fostering innovation.

In recent years, this project has had big impacts.

- Members developed **poultry breeding lines** with defined genetic characteristics, enabling research on immune response and disease resistance.
- Project members used existing tools like CRISPR/Cas9 and created new tools to identify specific **disease-resistance genes.** As a result, poultry companies can now evaluate their breeders for these genes and enhance the frequencies of favorable genes in their populations.
- Studies on immune response have helped design effective, safe **vaccines** for avian diseases. For example, project members discovered, developed, and patented the principal component of Marek's disease vaccines now used by all poultry companies. Researchers also identified mechanisms associated with Marek's disease virus evolution of virulence and how vaccines have contributed to this process.
- Identification of genes associated with resistance to **heat stress** and **Newcastle disease virus** will help breed chickens that are better adapted for hot climates. This is particularly important for indigenous chickens in developing countries where vaccine access and administration can be difficult.
- Discovery of a group of genes (MHC-Y) has allowed poultry breeders to select for increased resistance to pathogens like *Campylobacter,* a common cause of human **foodborne illness**. Other insights are helping develop strategies that improve poultry immune response to *Salmonella*, another common causes of foodborne illness.
- Project members are working on a survey of **infectious bursal disease virus** in poultry populations to determine which virus mutations the industry should watch out for and which should be included in vaccines for optimal protection.
- Studies revealed level of persistence of high and low pathogenic **avian influenza** viruses in poultry footbaths, manure, and litter. Researchers also studied litter amendments that could reduce the virus' persistence.
- Insights into the pathogenesis of **avian reovirus infections** and **runting-stunting syndrome** will help design preventative measures.
- Scientists identified potential **feed amendments** that could augment poultry immune responses. For example, studies showed that probiotic and postbiotic products can mitigate necrotic enteritis in poultry, and a thymol-based botanical blend was able to clear *Salmonella* Enteritidis in broilers when conventional antibiotics were not effective.
- Between 2013 and 2023, project members published 380 peer-reviewed publications in high-impact journals, 32 book chapters, and 18 technical reports. These works have been **widely cited**.

These efforts support a sustainable poultry industry in which animals are healthy, consumers enjoy safe, high-quality meat and eggs, and producers thrive.



NE2334: Avian Disease Resistance and Immunity (2023-2028) is supported in part by USDA NIFA through Hatch Multistate Research Fund allocations to participating State Agricultural Experiment Stations at land-grant universities. Current participants include: University of Arkansas, Auburn University, University of California, Davis, University of Delaware, University of Georgia, University of Illinois, Iowa State University, University of Maryland, North Carolina State University, The Ohio State University, West Virginia University, Western University, and USDA-ARS. Previous and future iterations of this project may include other participants and partners. Participants may receive additional funding from other sources. **Learn more:** https://nimss.org/projects/19036

This Impact Statement was produced in 2025 by the Multistate Research Fund Impacts Program, which is supported by agInnovation, the State Agricultural Experiment Stations, and the Hatch Multistate Research Fund provided by the USDA NIFA. **Learn more:** mrfimpacts.org

Multistate Research Fund IMPACTS

agInnovation science that feeds the world