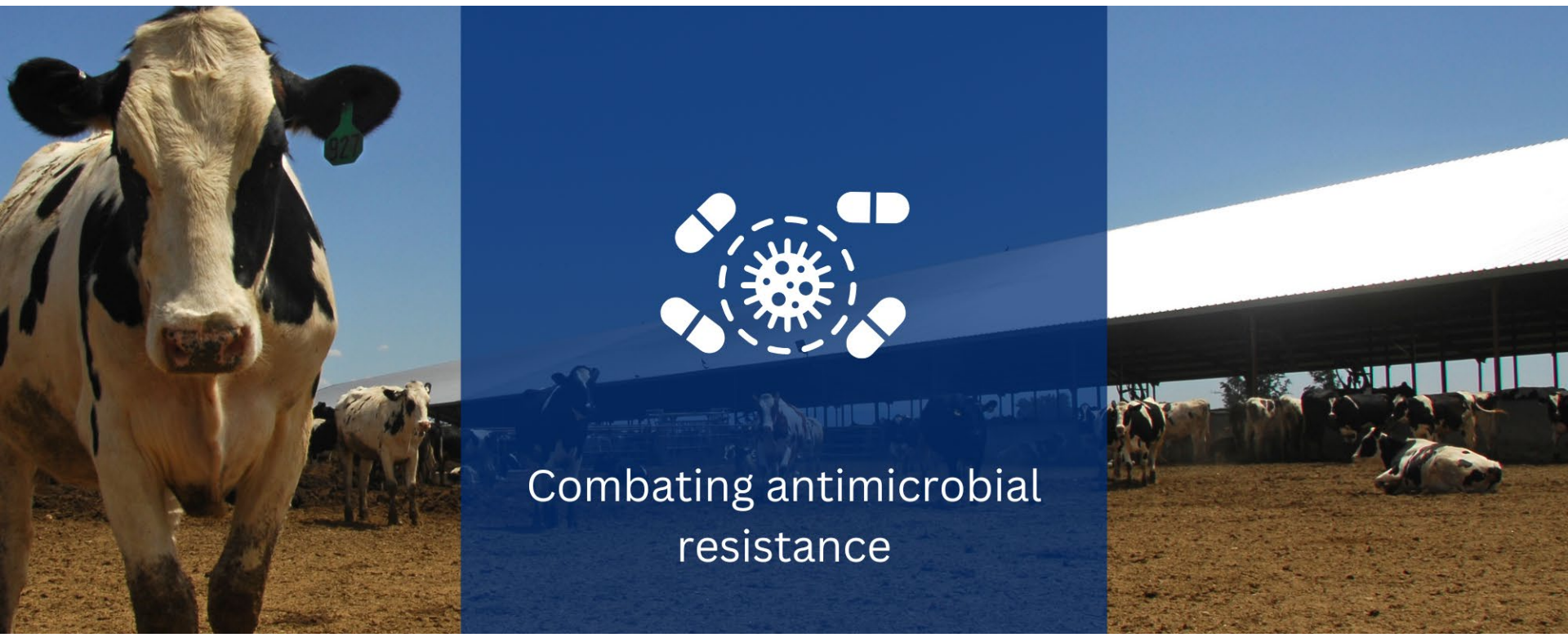
Agricultural Research Service
U.S. DEPARTMENT OF AGRICULTURE

How ARS Does It:
Prioritizing Animal, Human, Plant, and Environmental Health

Antimicrobial resistance (AMR) occurs when microorganisms, such as bacteria, viruses, fungi, and parasites, change over time and no longer respond to medicines. This can make infections harder to treat and increase the risk of disease spread, severe illness, and death. AMR is a global health threat. The World Bank estimates that AMR could cause ten million deaths annually by 2050 and cost the global economy up to $100 trillion. ARS has a unique role in identifying AMR in animal, plant, environmental, and foodborne pathogens.



ARS researchers study the ecology of AMR in agricultural and natural systems; the susceptibility of foodborne pathogens to biocides such as preservatives and disinfectants; and antibiotics critical to human medicine. ARS research efforts include developing ways to prevent agrochemicals from negatively affecting soil systems and assessing poultry immune responses to microbiologically safe products. The following 2022 accomplishments highlight ARS advances in optimizing the use of and reducing the need for antibiotics in agriculture.

Iron and biochar interaction increases chemical sorption capacity of biochar. Antibiotic chemicals are increasingly being detected in the environment. ARS researchers in St. Paul, Minnesota, examined the potential use of biochar to reduce the presence and availability of antibiotics in agricultural soils, as well as simple biochar pretreatments with iron salt solutions to increase biochar's effectiveness in removing antibiotics. Modifying the biochar with an iron-salt solution nearly doubled the increase in the observed antibiotic sorption capacity of the biochar. They also found that adding the iron-treated biochar to the soil system increased retention of antibiotics in the system by more than 2 days, thus reducing the amount of antibiotics entering the ground water supply. This information provides guidance for using biochar to mitigate antibiotics and other agrochemicals in the soil system. (NP 211)

Nutritional mediated induction of immunity in breeder hens increases immune protection in chicks. Young chicks are susceptible to many different pathogens, including Salmonella, during the first week after hatch. Salmonella colonizes the intestinal tract of young poultry and is one of the leading causes of human foodborne illness. As poultry producers move away from routine antibiotic use, there is a growing need to identify alternative approaches to protect and boost the natural immune responsiveness of newly hatched chicks. ARS researchers in College Station, Texas, working closely with industry and academic partners, showed it was possible to confer transgenerational protection against Salmonella colonization in young chicks by feeding the parent hens a diet supplemented with a blend of natural botanicals. They demonstrated that hens consuming a natural antibiotic alternative could produce chicks with a more robust immune response and that are more resistant to colonization by Salmonella. The work represents a significant contribution to the goal of providing U.S. consumers with poultry products that are microbiologically safe. (NP 108)

NARMS framework for isolating and monitoring AMR Salmonella enterica from surface water. The National Antimicrobial Resistance Monitoring System Environmental Working Group (NARMS EWG) was established and tasked with developing a science-based, statistically valid framework for NARMS surface water monitoring of AMR enteric bacteria. A framework for the program was established and methods optimized for the recovery and isolation of antibiotic-resistant Salmonella. ARS researchers in Beltsville, Maryland; Riverside, California; Athens, Georgia; Maricopa, Arizona; and Clay Center and Lincoln, Nebraska, led collaborations with EPA and FDA partners to optimize program design and to refine and improve four different protocols for recovering Salmonella from surface water. Protocols were shared with all members of the NARMS EWG and made publicly available on protocols.io. As a result of ARS input, a robust scientific approach to better understand the contributions and persistence of bacterial AMR in U.S. surface water was developed and is being implemented and coordinated across the United States by these Federal agencies. (NP 108)

Antibacterial activity and stability of a new antimicrobial peptide. The increasing prevalence of antibiotic resistance among pathogenic microbes highlights the urgent need for the identification and development of alternatives to antibiotics. Antimicrobial peptides (AMPs) are highly effective against microbial pathogens that cause diseases in humans and animals, but they are sensitive to proteases and kidney clearance. ARS scientists in Ames, Iowa, developed a stable peptide and tested it for resistance against degradation, stability, toxicity, and in vitro and in vivo antibacterial activities against *Histophilus somni*, a bacterium causing respiratory diseases in cattle. The peptide was able to kill *H. somni* very efficiently. These results demonstrate the possible use of an alternative treatment for controlling bacteria that cause respiratory diseases in cattle. (NP 103)

Learn more about National Program 103

Learn more about National Program 108

Learn more about National Program 211

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