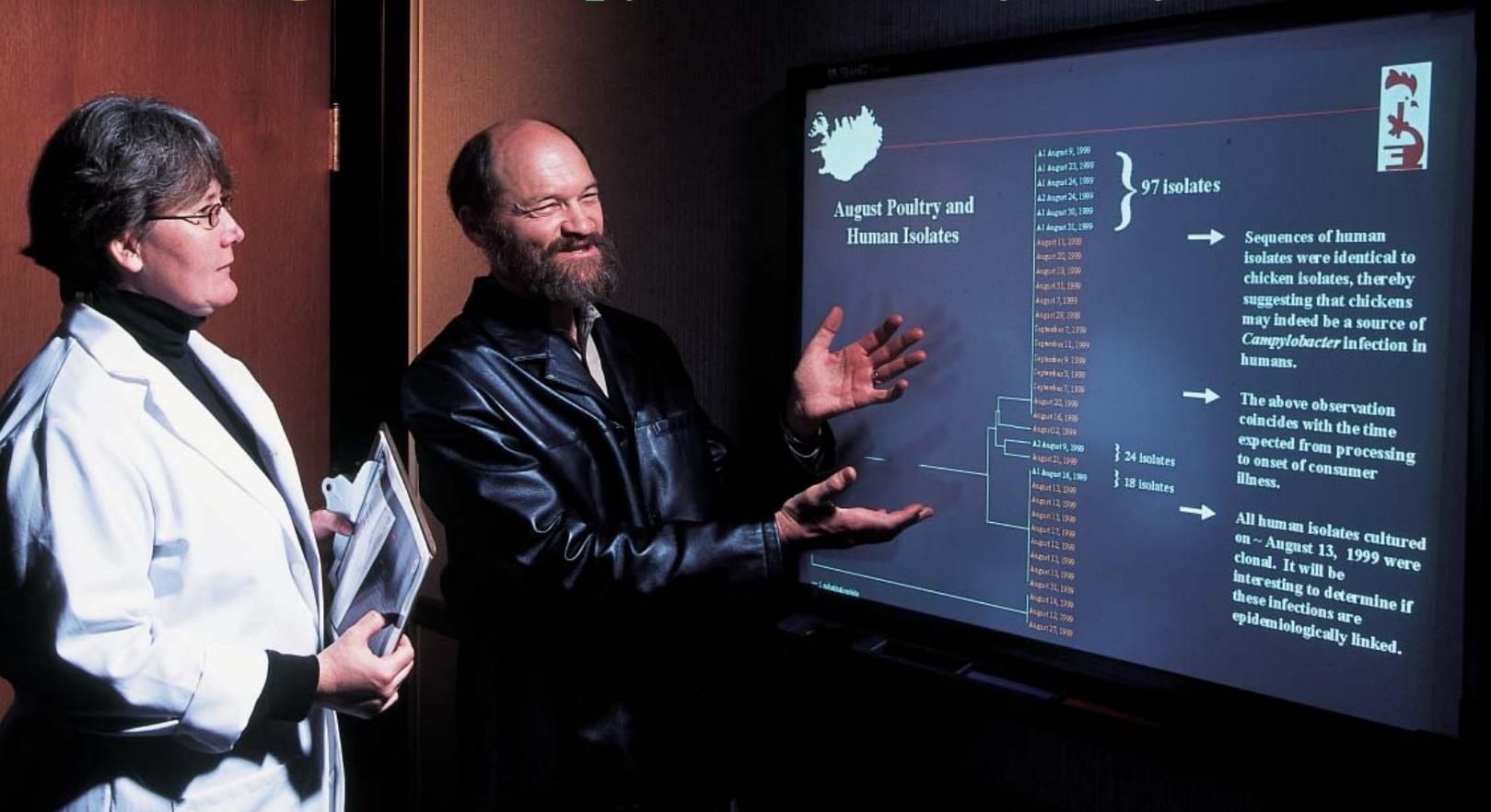


# Solving the *Campylobacter* Mystery



Research leader Norman Stern and microbiologist Kelli Hiatt analyze dendrograms to determine epidemiological relationships of Icelandic poultry and human *Campylobacter* isolates.

The age-old question of which came first, the chicken or the egg, is one scientists are pondering as they search for the source of *Campylobacter*, a foodborne bacterium that causes a human illness called campylobacteriosis. To find the answer, researchers from the Agricultural Research Service and the Canadian Food Inspection Agency traveled to Iceland.

Why? Because Iceland has qualities that make such a study worthwhile. It has a closed agricultural system, meaning that almost all foods consumed by its inhabitants are produced within its borders. Poultry production in Iceland is no exception. It is an integrated approach with a high degree of control; breeder eggs are obtained from Sweden, hatched in

Iceland, and quarantined at rearing farms. The birds at these farms are the breeders that lay eggs intended for broiler production. Access to poultry houses is limited to veterinarians and farmers. Additionally, water sources and nearby domestic livestock can be thoroughly investigated to assess their contributions to broiler flock infection.

Iceland's poultry industry could be seen as a smaller version of the industry in the United States, since they operate in similar ways. "There is a thousandfold difference in the size of the two countries, which translates the goals of the program from nearly impossible in the United States to manageable in Iceland," explains Norman J. Stern, research leader for ARS' Poultry Microbiological

Safety Research Unit. "Iceland's size allows researchers to exhaustively study the *Campylobacter* problem."

Iceland also has one of the highest standards of public health in the world, including monitoring its food supply. A zero-tolerance policy is in place for *Salmonella* in the poultry population. If these bacteria are present, the flock that harbors them is destroyed and the facility sanitized. *Campylobacter*, however, has become a problem in Iceland as it is here in the United States.

Because of its socialized system of health care, Iceland also monitors human disease closely and keeps detailed records. The system allows a source of illness to be traced back from the sick person more easily and quickly than in

the United States. *Campylobacter* is the most common bacterial cause of diarrhea in the United States. The Centers for Disease Control and Prevention estimates there are more than 2 million cases of campylobacteriosis each year. Iceland, with its insulated poultry industry, was the ideal place to research the source of *Campylobacter*.

The researchers in ARS' Poultry Microbiological Safety Research Unit believe they have found one major source of *Campylobacter*: the fertile chicken egg. Historically, possible sources of *Campylobacter* were thought to be the feed, wild birds, well water, insects, and rodents. Through inoculation studies, scientists showed that the bacteria couldn't survive longer than an hour in dry conditions, eliminating bird feathers and hatchery transport paper pads from the list of possible sources. Attention then focused on poultry feces, which are moist and provide the environment needed for *Campylobacter* to survive. By use of genotyping (DNA sequencing of genetic material), a specific gene in *Campylobacter* was isolated from fecal samples and used as a marker to identify identical *Campylobacter* organisms.

Microbiologist Kelli L. Hiett is conducting molecular analysis of broiler production samples collected in the search for the source of *Campylobacter*. "We can determine the genetic profile relationships of the isolates," says Hiett. *Campylobacter* organisms from a broiler-breeder flock and its broiler offspring were found to be identical, even though the flocks were housed 20 miles apart. The two flocks had no contact, other than that the eggs from the broiler-breeder operation were transported 20 miles to the broiler hatchery.

Evidence suggests that the only way the same *Campylobacter* isolate could have traveled from one location to the other is for it to have been in the moist confines of the egg. Since previous studies showed *Campylobacter* cannot

survive in a dry environment, if the *Campylobacter* bacteria were on the egg surface, it would dry out and perish during transport. Once the organism dries out, it becomes undetectable by known methods.

The reproductive tracts of breeder hens were then tested, and *Campylobacter* was present. Experiments are now under way to determine whether breeder flocks are the most important source of

SCOTT BAUER (K9415-11)



**Hiett obtains an isolate of *Campylobacter* from an ultra-low-temperature freezer at the ARS Poultry Microbiological Safety Research Unit. The unit stores over 5,000 *Campylobacter* isolates from 5 continents.**

these bacteria. Says ARS microbiologist Nelson A. Cox, "*Campylobacter* was found all through the egg-making machinery of the breeding hens, though we still don't know the mode of action of the bacteria."

Three years ago, during discussions between scientists from the Poultry Microbiological Safety Research Unit and various scientific agencies in Iceland, it occurred to researchers that

perhaps they could conduct epidemiologic studies on *Campylobacter* in broiler operations and track it through human incidences of campylobacteriosis. Iceland was an ideal location to test sources of infection, since the country produces 100 percent of the broilers consumed within its borders. Even though Icelanders consume only about one-quarter the amount of poultry Americans do, campylobacteriosis is much more prevalent in Iceland than in the United States. Human and chicken biological samples were collected in Iceland and shipped to the United States for genotyping.

Through DNA sequencing of Icelandic poultry and human isolates, researchers were able to prove the DNA sequence profiles of the isolates are identical. "We can also see that the time from processing the poultry product to consumption and onset of human illness is consistent with poultry being the initial source of the human isolate," says Hiett. "Ninety percent of human isolates of *Campylobacter* had genetic fingerprints identical to those found in chickens," explains Stern.

Ultimately, the ongoing research may determine the major sources of transmission and lead to a way to reduce the presence of *Campylobacter* or prevent it from entering the marketplace. The Canadian researchers are conducting risk analyses and developing models with varying parameters. But, for the purposes of finding the source of *Campylobacter*, Cox says, "Iceland was the research opportunity of a lifetime."—By **Sharon Durham, ARS.**

*This research is part of Food Safety, an ARS National Program (#108) described on the World Wide Web at <http://www.nps.ars.usda.gov>.*

*Norman J. Stern is in the USDA-ARS Poultry Microbiological Safety Research Unit, 950 College Station Rd., Athens, GA 30603; phone (706) 546-3516, fax (706) 546-3771, e-mail [nstern@saa.ars.usda.gov](mailto:nstern@saa.ars.usda.gov).* ♦