



New Campylobacter Vaccine for Poultry

A way to reduce food-borne illness in humans

By Susan McGinley

Scanning electron microscopy shows the string-like adhesion molecule for *C. jejuni* on a surface membrane in a laboratory. This simulates what happens when it adheres to the host's intestine.

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ost people are familiar with *Salmonella* and its potential to make people ill. But fewer know about *Campylobacter jejuni*—even though it makes more people sick. Raw chicken is one of the most common carriers of the bacteria, often encountered

when cooked meat is placed on unwashed cutting boards previously used for trimming raw chicken, or when chicken is not cooked to 165 degrees Fahrenheit.

“Campylobacter is now the number one food-borne pathogen in the United States and the world, surpassing Salmonella,” says Lynn Joens, a professor in the University of Arizona Department of Veterinary Science and Microbiology. “In the United States alone, 2.4 million cases are reported annually, with costs exceeding \$1 billion.”

A new poultry vaccine in development at the UA offers a unique approach in controlling *Campylobacter jejuni* infection in chickens before it reaches the dinner table. In research trials the vaccine has significantly reduced the pathogen’s ability to colonize young chickens’ intestines, where the infection begins. The goal is to halt the contamination before it spreads and survives on raw chicken sold in stores.

“Yet chickens don’t actually cause the disease (nor does it make them ill). It’s the organism they carry that makes people sick,” Joens says. “Right now you can go to any grocery store, get a raw chicken, test it in a laboratory and find *Campylobacter jejuni*. Twenty to 80 percent of all broiler houses become contaminated with *Campylobacter*.”

The most common symptoms of human *Campylobacter* poisoning, which mimic those of *Salmonella* and other gastrointestinal pathogens, include fever, cramps, watery diarrhea and sometimes dysentery. More severe infections can lead to peritonitis, autoimmune disease or death.

Funded by the U.S. Department of Agriculture, Joens and graduate students in the Department of Veterinary Science and Microbiology started analyzing *Campylobacter*’s infection process about four years ago, looking for a way to interrupt it. The laboratory team, which included graduate research associate James Theoret and assistant research professor Bibiana Law, eventually discovered that the pathogen first attached itself to the surface of the chick’s intestines and then began to multiply. Attacking the “sticking” mechanism seemed to be the key.

When the UA researchers sequenced the intestinal surface protein they identified the gene responsible for producing *Campylobacter*’s adherence protein. Then they built a trial vaccine around it using *Salmonella* bacteria as a vector, with the assistance of Roy Curtiss, professor and director of the Center for Infectious Diseases and Vaccinology at Arizona State University.

Curtiss’ group inserted the adherence gene into *Salmonella* bacteria, which is nonpathogenic for poultry. The resulting live vaccine, containing *Salmonella* programmed to make the *Campylobacter*’s adhering protein, was fed to young chickens to protect them.

“Once the *Salmonella* in the vaccine produced the *Campylobacter* protein, the chicks made antibodies against it in their intestines,” Joens says. “In our first study of 15 birds we got a very significant reduction—98 percent—in *Campylobacter* infection, compared with a control group. We’re now repeating the trial on a larger scale.”

The vaccination process is simple, easy to produce and protective to the chick, according to Joens. The *Salmonella* lives four to five days, enough time to stimulate antibody production, and dies. Chickens need to be vaccinated early because they become infected at just two to three weeks of age.

Joens’ preliminary figures show that 270 million *Campylobacter* organisms were present in non-vaccinated birds, compared to 67,000 organisms in the vaccinated birds.

“You need at least 500 organisms to produce disease in humans,” he explains.

“The chlorine in the packinghouse chillers usually reduces numbers of bacteria by 1,000 to 100,000 organisms, so the chickens should be free of *Campylobacter* after processing.”

The UA group was the first to discover the adherence protein, which is only produced when *Campylobacter jejuni* colonizes certain surfaces, like chicken intestine and skin. They have a patent pending in both the United States and the European Union for the gene that produces it.

“If everything goes right we could have a commercial vaccine in three to five years,” Joens says. The vaccine’s effect could be significant: about 8.9 billion broilers go to market annually in the U.S., with a value of \$21.5 billion. Europe has similar broiler production figures. Americans consumed 86 pounds of chicken per person in 2006, the most recent numbers available.

“The vaccine would be a great intervention method for *Campylobacter* when the USDA and FDA (Food and Drug Administration) mandate reduced numbers of food-borne pathogens in chicken—probably in two to three years,” Joens says. “Once it becomes available, the vaccine should cost about a penny per chick. More importantly, it should greatly reduce the number of cases of human *Campylobacter* gastroenteritis.” ★

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