

The Cat/Pig Toxoplasmosis Connection

A sparkling, crisp fall day, a tidy enclosure where young hogs happily munch from brimming feed troughs, a plump farm cat sitting just outside the enclosure, calmly licking her paws and rubbing her whiskers: What's wrong with this picture?

J.P. Dubey's reply would probably be "plenty." Dubey is an Agricultural Research Service parasitologist and expert on *Toxoplasma gondii*, a parasite that infects animals and humans worldwide.

Of all the creatures infected, cats are the only ones known to excrete *T. gondii* oocysts, a form of the parasite that easily withstands nature's harshness. And an uncovered feed bin would be a tempting spot for a wandering farm cat to deposit oocyst-laden feces, opening the door to possible swallowing of the oocysts by hungry hogs, Dubey warns.

"Infection of swine with *Toxoplasma gondii* creates a public health concern because the parasite can be transmitted to humans through the handling and consumption of raw or undercooked pork containing tissue cysts of the parasite," explains Dubey. He is with the ARS Parasite Biology and Epidemiology Laboratory at Beltsville, Maryland.

"However, it's not known how much *T. gondii* transmission to humans is through pork and how much is through direct contact with farm or house cats."

Toxoplasma gondii can exact a terrible toll in vulnerable humans. Healthy people other than pregnant women can weather the infection with few ill effects. But if a pregnant woman becomes infected, there is a 20 to 50 percent probability that her baby will be infected, possibly resulting in blindness, mental retardation, or other medical prob-

lems for the child. In about 1 in every 1,000 pregnancies in this country, a child is born infected with *T. gondii*. The national cost of raising children infected in this way was estimated in 1993 to be \$5.3 billion.

Infection with *T. gondii* can also be devastating for people whose immune systems are impaired, such as through chemotherapy treatment, in conjunction with an organ transplant, or through acquired immunodeficiency syndrome (AIDS). It has been estimated that as many as 1 in 10 AIDS patients in the United States dies of toxoplasmosis.

In 1990, ARS was asked by the National Pork Producers Council to investigate how pigs become infected with *T. gondii* under farm conditions.

"Working with R.M. Weigel of the University of Illinois, we surveyed 47 Illinois swine farms in 1992 and 1993," Dubey recalls. "We trapped wildlife around the farm and

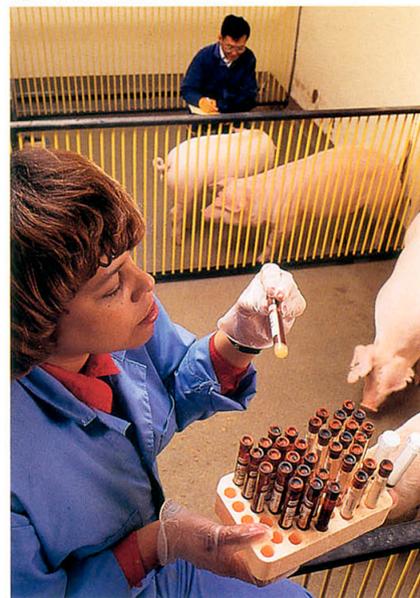
checked their blood for *T. gondii* infection, took blood samples from the pigs, and checked samples of feed, water, and soil six different times."

The results: Farm cats were found to be the most likely source of *T. gondii* infection, with about two-thirds of the 300-plus cats checked showing signs of previous exposure to the parasite.

"The significant point is that if a cat has antibodies to *T. gondii* in its

The same study showed that cats could have very high levels of antibodies against *T. gondii* in their blood years after a previous infection and still become reinfected.

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Biological lab technician Diane Hawkins-Cooper and microbiologist Sam Shen collect blood samples from pigs to examine for *Toxoplasma* antibodies. (K7065-12)

blood, it's already shed the oocysts and they're sitting somewhere in the environment," warns Dubey. "A cat will shed oocysts within a week of getting infected, but it won't have antibodies in its blood until 3 or 4 weeks later."

While an infected cat sheds for only about a week, the oocysts released number in the millions. To make matters worse, Dubey says, the oocysts can survive freezing and thawing, allowing them to linger in the environment for years.

"Of all the factors we examined in swine exposure to *T. gondii*, the access of *T. gondii*-infected cats to the feed was the most important—more than mice in the feed," Dubey notes. "Outdoor housing of the pigs was not a contributing factor.

"This means producers need to make sure their feed supplies are

covered and cats can't get into them—especially young cats, because they're more likely to shed the oocysts. Also, producers should keep cats away from the water and soil around their hog operations."

On the positive side, the incidence of *T. gondii* infestation in swine appears to be declining, Dubey reports. A national survey in 1983-84 calculated 23 percent of market-aged swine had been infected with *T. gondii* at some point. The more recent Illinois check of 7,000 market pigs and about the same number of sows found indication of infection in only 3 percent of the market pigs and 15 percent of the sows.

More good news involves testing of a commercially developed vaccine that could help break the *T. gondii* - cat connection.

"The vaccine contains a living form of the parasite. But it's a genetic mutant, so its life cycle is not completed, and it can't produce oocysts," Dubey says.

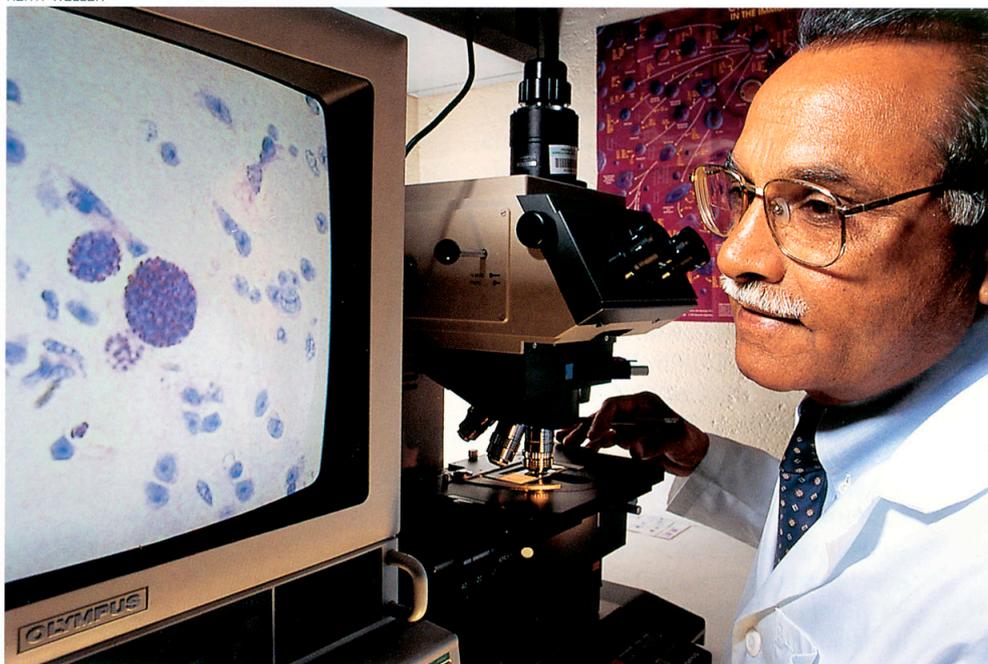
"Cats vaccinated with this become immune to infection by *T. gondii* and don't shed the oocysts. But you'd have to give this vaccine every year—and especially to newborn weaned kittens, because they're a main source of infection."

The vaccine is not yet on the market, however. It may come in 1 to 2 years, when review of test data has been completed.

This protection is more important than ever, in light of a startling discovery by Dubey and his research team. It was previously believed that once a cat had been infected with *T. gondii* and shed oocysts, that cat would not become re-infected and shed more oocysts.

Dubey's team has found that's probably wishful thinking. They have shown that cats infected years earlier and that shed millions of oocysts then

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In his lab, microbiologist J.P. Dubey examines swine tissues for *Toxoplasma* parasites. (K7064-4)

could be reinfected 6 years later and begin shedding oocysts again.

That wasn't the only surprise. The same study showed that cats could have very high levels of antibodies against *T. gondii* in their blood years after a previous infection and still become reinfected. "So you can't use high levels of antibodies as an indicator of immunity," says Dubey.

As part of their efforts to protect the public against *T. gondii* infection, the Beltsville researchers are working on development of a vaccine for pigs.

"If the pig has had this vaccine and gets infected, the vaccine would reduce the number of parasites present in the pig's tissue," Dubey says. "We know the effectiveness of the vaccine lasts at least 9 months. We hope to have this vaccine ready within the next 5 years."

In the meantime, consumers already have excellent weapons at hand to protect themselves against *T. gondii* ingestion through meat.

"Freezing the meat for a single day in a domestic freezer is very effective for killing the tissue cysts, which are the form of the parasite that's in meat," Dubey points out. "Also, cooking the meat to an internal temperature of 153°F will kill them. Tissue cysts are much more vulnerable than the oocysts."

Collaborative studies with microbiologist Donald W. Thayer at ARS laboratories in Philadelphia, Pennsylvania, have shown irradiation is also quite effective.

"Irradiating the meat at 0.5 kiloGray will kill the *T. gondii*," Dubey says. "And the FDA has already approved irradiation of fresh pork carcasses to 1 kiloGray for control of *Trichinella spiralis*."—By **Sandy Miller Hays, ARS.**

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