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Preventing Mad Cow Disease

Mad cow disease is scientifically known as bovine spongiform encephalopathy (BSE). It is a fatal disease that has recently received much attention because the disease can be transmitted from cow to cow or even from cow to people. The medical profession calls this disease Ceutzfeld-Jakob disease, or vCJD, when the prion proteins affect the brains of people.

The disease is spread through ingestion or the handling of infected beef. I know cows are supposed to be herbivores, not carnivores, which means that if they could speak they would say "Where's the grass?" rather than "Where's the beef?" So if cows don't eat cows, how did this disease start to infect herds of cattle? It seems European cattle farmers decided to save money by using animal parts as a protein supplement in their cow feed in place of the soybean enrichment used in the United States.

BSE manifests itself in a malformed protein that twists normal prion proteins into a diseased shape. Ingested diseased proteins in the new host create abnormal prions that act as an infectious disease by twisting more prions into diseased shapes until so much of the animal's brain is destroyed that normal life functions cease to exist.

According to the Center for Disease Control (CDC) (www.cdc.gov/ncidod/dvrd/vcjd/qa.htm#bseinus), BSE has only been diagnosed in three U.S. cows. The first, a Washington State cow (diagnosed in December 2003) was imported from Canada. The second (June 2005) was a Texas-born cow with no link to Europe or Canada—so how this cow was infected is a major concern. The most recent infected cow was diagnosed in March 2006. It was 10 years old, lived in Alabama and its geographic past is unknown. "Due diligence" is the CDC's only weapon for preventing further cases of BSE. The future might hold a better solution.

Hematech Inc, a Sioux Falls, SD, biotech company, has found the ultimate way of preventing BSE. It has genetically engineered cows that have no prion proteins. The company used sequential gene-targeting to deactivate the PRNP gene that is responsible for the development of prion proteins in naturally born cows. The steps in Hematech's process are too complex and technical for a detailed explanation. Basically, though, the company disrupted two specific alleles (gene forms) needed to develop PRNP genomic DNA. These PRNP-free fetal cell lines were then re-cloned to produce PRNP-free calves. Photo 1 shows cryopreserved genetically-modified cows fibroblast cells being selected for cloning.

Photo 1—Selecting cells for cloning

Hematech monitored its PRNP-deficient cloned Holsteins for 20 months to make certain that the gene deficiency didn't effect normal growth. All testing compared these animals to a naturally produced control group. Hematech analyzed every aspect of growth and health from heart rate to feces. It compared tissue samples and found no significant differences in any of the cell groups that were analyzed.

Hematech even studied whether cows presented the same behaviors when exposed to normal environmental stimulations. Its studies concluded that the PRNP-deficient cows were physically identical to the control group. However they were more sensitive to menacing sounds and movement.

The billion-dollar question is: Can these genetically altered cows (Photo 2) still catch and spread BSE? Initial tissue testing so far shows the PRNP-deficient cows won't catch or spread the disease. To see if they are fully immune, Hematech has directly injected BSE into a number of PRNP-deficient Holsteins.

Eventually the Food and Drug Administration (FDA) will have to decide if genetically altered cloned cows are safe to enter our food supply. The FDA has recently decided that milk and meat from genetically unaltered animals that have been created by cloning are not only safe to eat, but can be sold with the same labeling as food products from their naturally created relatives.

Photo 2—Cloned cattle

Recalling the Facts

1. Why did BSE first show up in Europe rather than the United States?
2. How do BSE malformed proteins affect normal prions?
3. What steps has Hematech taken to prove that its cows will be safe to eat and BSE free?

Alan Pierce, Ed.D., CSIT, is a technology education consultant. Visit www.technologytoday.us for past columns and teacher resources.