
Bovine spongiform encephalopathy

HYCLONE SERA

What is bovine spongiform encephalopathy?

Bovine spongiform encephalopathy (BSE) is a rare, chronic, degenerative, neurological disease of cattle that affects older adult animals. BSE is a member of a family of diseases called transmissible spongiform encephalopathies (TSE). BSE was recognized for the first time in the United Kingdom in 1986.

How many TSE diseases are there?

In addition to BSE, TSE diseases include scrapie (affecting sheep and goats), chronic wasting disease (affecting deer and elk), sporadic and variant Creutzfeldt-Jakob disease, Kuru, Gerstmann-Straussler syndrome, fatal familial insomnia (affecting humans), and transmissible mink encephalopathy (affecting mink).

Can BSE be transmitted to humans?

Yes, but human diseases are rare. Sporadic Creutzfeldt-Jakob (CJD) disease happens naturally at random and normally affects older adults. Strong scientific evidence indicates that variant Creutzfeldt-Jakob disease (vCJD) and BSE are caused by the same prion protein. Kuru was transmitted human-to-human via cannibalism. Gerstmann-Straussler syndrome and fatal familial insomnia are genetic and sporadic. To put vCJD in perspective, each year in the US alone, about 100 people die from lightning strikes and about 36 000 people die from influenza. Since 1996 when vCJD was first reported, about 227 affected people have been identified.

What causes BSE?

The theory accepted by most scientists is that BSE is caused by an infectious prion. Dr. Stanley Prusiner was awarded the Nobel Prize (for physiology/medicine) in 1997 for his work in developing this theory and understanding of the agents associated with TSE diseases. The agent does not give rise to a detectable immune response and is resistant to inactivation. Some still entertain the possibility that BSE is caused by an unusual virus.

What is a prion?

Prions are infectious protein particles that cause fatal neuro-degenerative diseases.

How do prions cause BSE?

For unknown reasons, normal proteins transform in massive amounts in the brain, causing a cascade of progressive, incurable degeneration. These abnormal prions leave holes in the brain tissue resulting in a sponge-like appearance, hence the name *spongiform*.

How is BSE transmitted?

BSE is transmitted by bovine consumption of ruminant animal feed that is contaminated with previously infected bovine central nervous system tissue. It is believed that bovines were first infected with BSE when farmers fed cattle feed derived from sheep byproducts that were infected with the scrapie agent. Feeding practices in the US and Canada prior to 3 August 1997 permitted the use of animal byproducts of beef slaughter in feed supplements for cattle. In early August 1997, the US Code of Federal Regulations "Animal proteins prohibited from use in ruminant feed, Title 21, Part 589.2000" became effective, which meant that using animal protein in cattle feed was no longer allowed. This ban is commonly known as the *ruminant feed ban*.

What are the symptoms of BSE?

BSE causes progressive degeneration of the central nervous system, which in turn can cause several symptoms, such as changes in temperament (nervousness, unwillingness to move through doorways, belligerence), drooling, muscular tremors, uncoordinated gait, itchiness about the head, abnormal postures, decreased milk production, loss of body weight despite a normal appetite, and is always fatal. It is because of these symptoms that BSE is sometimes referred to as *mad cow disease*.

What is the incubation period of BSE?

BSE usually manifests itself two to eight years after exposure to contaminated feed. Once clinical signs of the disease are present, the health of the animal typically starts to deteriorate over a period of two weeks to six months.

What is a ruminant?

A ruminant is any animal that chews its cud. These animals include (but are not limited to) cattle, goats, sheep, buffalo, deer, elk, antelope, and moose.

What is ruminant feed?

Ruminant feed is any feed that a ruminant consumes. The Association of American Feed Control Officials (AAFCO) has identified several ingredients in their official publication as being prohibited for feeding to ruminants (see their website at aafco.org for details). The list of prohibited animal byproducts is intended to prevent the spread of BSE.

How is BSE diagnosed and treated?

At this time, there is no assay available to test for BSE in live animals. Positive confirmation of BSE can be diagnosed post-mortem by Western blot or ELISA analysis of brain, spinal cord, or distal ileum tissue. Special tests are needed to confirm the presence of abnormal prion proteins.

How can BSE be prevented?

As infected animal feed is the source of transmission, the U.S. Department of Agriculture (USDA) established regulations to prohibit the use of ruminant feed in the US. To prevent the disease from coming into the US, the USDA has banned importation of live ruminants and ruminant byproducts from countries where BSE is known to exist. Cattle to be slaughtered are inspected both pre- and post-mortem to ensure that illness or disease is not present. Also, in December 2003, the USDA announced that several safeguards would be put into effect to reduce the risk of BSE in the food chain. Those safeguards are:

Downer (or non-ambulatory) animals:

These animals are banned from the food chain.

Product holding:

USDA Food and Safety Inspectors will no longer mark cattle for BSE testing as *inspected and tested* until confirmatory testing for BSE is in fact completed and negative.

Specified risk material (SRM):

The USDA will expand its list of specified risk material, which now includes skull, brain, trigeminal ganglia, eyes, vertebral column, spinal cord, and dorsal root ganglia of cattle over 30 months of age, and the small intestine of cattle of all ages. This SRM will not go into the food chain.

Advanced meat recovery (AMR):

AMR is an industrial technology that removes muscle tissue and bone from beef carcasses under high pressure without including bone meal (when used properly). Updated regulations state that the spinal cord (and all spinal cord tissue, nerve cells, etc.) and the dorsal root ganglia cannot be labeled as meat and are prohibited from going into the food chain.

Mechanically separated meat:

The USDA prohibits mechanically separated meat from going into the food chain (this is a different technology than AMR).

Air-injection stunning:

To ensure that brain matter is not dislocated during the humane stunning of cattle prior to slaughter, air-injection stunning is prohibited.

Which government agencies are responsible to monitor BSE in the United States?

The USDA has primary responsibility for inspection and certification of the fitness of beef for human consumption at the point of slaughter. The US FDA is responsible for the integrity of the product once introduced into the food chain.

Can BSE be detected in bovine serum products?

At this time, there is no assay available to test for prions in bovine blood. In fact, the European Pharmacopoeia TSE Monograph (Ph. Eur. 2002, 5.2.8. Minimising the risk of transmitting animal spongiform encephalopathy agents via medicinal products) classifies all serum to be Category IV, or *no detectable infectivity*. There are no indications that vCJD is linked to the use of bovine serum in medicinal products, and it is felt that the risk posed by the use of bovine serum is remote and theoretical.

Does this mean that it is safe to use bovine serum in the manufacture of therapeutics?

Bovine serum is rich in growth factors, vitamins, and other components needed to sustain cell growth, and it is a critical component in the production of many drugs and vaccines. The World Health Organization (WHO) classifies serum as Category IV, no detectable infectivity. There are many biopharmaceutical applications that require bovine serum, and with proper precaution, the benefits greatly outweigh the risks.

Which countries have the lowest BSE risk?

The World Organization for Animal Health (OIE) continuously reviews bovine BSE risk. At the time of publication of this information, the United States, Australia, and New Zealand were all assigned the lowest risk level.

Does HyClone Laboratories collect bovine blood in the US state of Washington?

No.

Does HyClone Laboratories collect fetal bovine blood from cows that are designated as *downers*?

HyClone™ Laboratories collects fetal bovine blood only from those dams that have been declared by the USDA (via pre- and post-mortem inspections) to be fit for human consumption. After 30 December 2003, the USDA banned downer cattle from going into the human food chain.

If a cow were designated as a *downer*, would it be safe to assume that it is not healthy and therefore its fetus would not be healthy?

A *downer* designation generally means that an animal has an injury that makes it unfit to survive in a herd, but not necessarily that it has a disease. For example, it is common for cows to suffer birthing injuries that may result in paralysis of their hind legs, but they would not be unsafe to consume. However, the USDA has banned downer cattle from going into the human food chain.

Does Mexico abide by the 1997 ruminant feed ban like the US and Canada?

Mexico instituted their own law in 1999 that states it is prohibited to allow ruminant feed sourced from a known BSE country into Mexico, unless such feed is either treated at high temperatures or high pressure.

References

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