

Mad Cow Disease: Implications For World Beef Trade

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Mad Cow Disease, the commonly used name for Bovine Spongiform Encephalopathy (BSE), emerged in Great Britain in early 1985 with little notice. A cow exhibiting strange symptoms had died and was diagnosed with a newly discovered form of a Transmissible Spongiform Encephalopathy (TSE). The cause of the disease was unknown, and the impact of the disease was equally unknown at the time.

BSE has since been found to be incurable, untreatable, and fatal to both cattle and humans. Great Britain's and the rest of the European Union's beef industries have been devastated by BSE and consumer confidence in the safety of their beef supply, and food system in general, has been greatly diminished. Further, the potential spread of BSE, and its human form, to countries that have imported beef or products made from infected animals, and/or live ruminants from Great Britain or other European countries has significant human implications as well as economic implications for the world's beef trade.

Mad Cows and Englishmen – Where and How BSE Started

In December of 1984, cow number 133 on the Stent Farm in Sussex, England began developing head tremors and loss of coordination. In February of 1985, Cow 133 died and other cows began to display similar symptoms. Later that year, pathologists working for the British government determined that cow 133 died from a spongiform encephalopathy-type disease. In late 1986, British pathologists recognized this new spongiform encephalopathy as Bovine Spongiform Encephalopathy, a new cattle disease, and notified the government of their findings. As pathologists worked to understand the

nature and cause of BSE, the British government proceeded cautiously, not wanting to raise any unnecessary public fears, given the lack of knowledge of the disease. Not until 1988 did the government take action to halt the spread of BSE in cattle by passing the Bovine Spongiform Encephalopathy Order, banning the use of MBM (meat and bone meal) for sheep and cattle feed (Ainsworth). In addition to this legislation, Britain began enacting slaughter policies for infected cattle. Although scientists had yet to prove that BSE could be transferred to humans, the British government banned the use of high-risk offal (brain, spinal tissue, and spleen elements) for human consumption in 1989.

In May of 1990, British Agriculture Minister John Gummer staged a publicity stunt with the hope of easing rising public fears of British beef. Gummer, while being televised, encouraged his four-year-old daughter to eat a beefburger (USDA 2001b). Earlier that year however, scientists had proven that mice and a Siamese cat had contracted a BSE-like disease when injected or when they consumed a BSE contaminant. This was a clear indication that BSE could pose a threat across species barriers. By 1993, BSE had reached its peak with over 100,000 confirmed cases of infected cattle. During this time, the Chief Medical Officer tried again to reassure the public that British beef was fit for human consumption (Ainsworth). In May of 1995, 19-year-old Stephen Churchill died of a variant of Creutzfeld-Jakob Disease (vCJD) contracted from consuming BSE infected beef. Three more deaths occurred by the end of the year. Consequently, the British government publicly announced in 1996 that a “probable link” exists between BSE and vCJD. Just one week after the announcement, the European Commission imposed a worldwide ban on all British beef exports. This ban was lifted in

1999, along with a previously self-imposed British beef-on-the-bone ban, presumably with the hopes that the BSE problem was beginning to be controlled.

In 2000, France, Spain and Germany all reported cases of BSE and vCJD. France imposed bans on British beef products, while Germany enacted stricter testing of cattle to ease public fears. By the end of 2000, many countries throughout the world had imposed bans on beef products from 30 European nations. In January 2001, BSE was reported in Italy and Denmark (CNN).

The spread of BSE throughout Europe has created a ripple effect for policy change throughout the world. Nations, including the US, have been scrambling to implement monitoring systems and trade policies that keep their food systems BSE free. Asian countries such as Singapore and Thailand have imposed a ban on beef products from all nations identified as having BSE. Elsewhere in Asia, Malaysia, Australia and New Zealand have banned all beef products from EU member states. In the Middle East, Saudi Arabia has a ban on beef and beef derivatives in feed, while Jordan has banned beef, cattle and MBM from BSE-identified EU member nations (USDA 2001b).

Not long after BSE was first reported in 1986, the US Department of Agriculture (USDA) established the BSE Working Group to review the science of BSE and to make appropriate recommendations. Before BSE had been definitely linked to vCJD in humans, the US banned imports of British cattle feed in 1988 and live ruminants from the UK and other BSE nations in 1989. Throughout the early 1990s, the USDA educated veterinarians, cattle producers, and lab diagnosticians on the symptoms and diagnosis of BSE while conducting risk assessments. A surveillance program managed by the Animal and Plant Health Inspection Service (APHIS) was implemented in 1990 (USDA 2001a).

Under their surveillance program, APHIS takes samples of brain tissue from cattle exhibiting signs of neurological diseases, as well as random samples from “downer cattle” at slaughter. APHIS also works to investigate any neurological cases submitted to veterinary laboratories and teaching hospitals. By the end of October 2000, nearly 12,000 cattle brains had been analyzed in the US with no evidence of BSE found (USDA 2000a)

By 1997, the US had a ban on the import of most live ruminants and ruminant products. In addition, the FDA had prohibited feeding most mammalian protein to cattle and other ruminants. More recently, the US does not allow any individual who has spent six months or more in the UK since 1980 to donate blood (Cowley). The US has a ban on MBM, tallow/fats, beef products, cattle and pet food from all EU member states (USDA 2001b).

The Science of BSE and vCJD

Various theories have arisen on the cause of BSE. The most widely accepted theory to date is the protein-only hypothesis. In order to understand this theory, one must know some of the properties of proteins. Proteins are chains of linked-together amino acids. Different proteins can have a different number of amino acids, ranging from tens to approximately a thousand (Birbeck). There are 20 different kinds of amino acids that help determine the function of a protein. Some of these functions aid in digestion or help provide structure to ligaments and hair (San Diego). Proteins do not contain a nucleic acid genome, which is where genetic material is found. Genetic material, in the case of viruses and diseases, is what allows contaminant cells to attack and mutate the healthy cells of a host.

The protein-only hypothesis revolves around the concept of the prion, a term conceived in the early 1980s by Dr. Stanley Prusiner. A prion is the infective agent of various Transmissible Spongiform Encephalopathies, such as Scrapie in sheep, BSE in cattle, and Creutzfeldt-Jakob Disease (CJD) in humans. According to Dr. Prusiner, these infective prions contain an active, abnormal protein labeled PrP (Prion Protein) that is abnormally folded, and contain 250 amino acids compared with the 20 amino acids found in a normal protein. Normal animal cells create PrPC, a cellular PrP similar to PrP. The presence of the amino acids determines the form and function of the protein. Once introduced into its host, the PrPs force normal host proteins to convert into the abnormal PrP form.

Laboratory evidence suggests there is validity to the protein-only theory. Purification tests on infected brain tissue show the presence of PrPs, and the lack of any invasive genetic material associated with a virus. These tests are able to remove molecules that are not a part of the prion. Furthermore, in test tubes, scientists determined that PrPs would bind and convert PrPCs into the abnormal PrP form (Coghlan).

The defining characteristics of BSE in an infected host are becoming clear. BSE is a transmissible, degenerative disease that proves fatal in the host. Scientists have known that feeding cattle meat and bone meal (MBM) from previously infected cattle is the primary means of transmission. MBM involves grinding up the components of a cow that are not fit for human consumption, and turning them into a protein source for cattle feed (Rampton). This includes the brain and spinal tissue of cattle, where BSE is most highly concentrated in the infected animal. Since infective PrP has been shown to be

resistant to conventional forms of sterilization, cattle that are fed the infected MBM contract the disease. Once infected, the incubation of the disease varies somewhat. Scientists speculate that the incubation period in cattle is from three to eight years (FDA). Although cattle are by nature herbivores, the use of MBM has proved quite cost effective and, until recently, safe.

Once the disease becomes active, the infective agent attacks the brain and spinal tissue by creating sponge-like lesions. As the lesions permeate the brain, the infected animal begins exhibiting peculiar behavior. It will begin to drool, arch its back, or become aggressive to other cattle (Cowley). Eventually the infected animal will become unable to walk before succumbing to the disease. One final characteristic of BSE is the ability to cross the species barrier and infect humans with what has been classified as a variant of Creutzfeld-Jakob Disease (vCJD).

Creutzfeld-Jacob Disease has been recognized since the 1920s as a rare disease usually associated with heredity. Much like animal TSEs, CJD proves fatal and is only completely determinable by analyzing the brain tissue of a deceased victim for sponge-like lesions and plaque build-up. Most of the lesions are amassed in the cerebral cortex. The symptoms of CJD in humans parallel those of TSE's in animals. The CJD victim likely exhibits erratic behavior and has difficulty with memory and coordination. As the disease runs its course, the victim slides into dementia and ultimately loses control of all physical and mental functions (CJD Foundation).

The variant of CJD (vCJD) that is contracted from consuming beef contaminated with BSE differs only slightly from CJD. For CJD, the majority of the victims fall within the age range of 50-75 years. For the variant, however, many of the victims thus far have

been young. The median age of vCJD victims has been 28 (CDC). Although most of the victims have been young, recent events have shown victims of vCJD in the elderly, suggesting that the incubation period could be over 20 years in some individuals (HHS Fact Sheet). Unlike CJD, the sponge-like lesions are not amassed in the cerebral cortex. For vCJD, the lesions are located primarily in the cerebellum, which is near the base of the brain (Cowley). Currently, most countries do not have a defined system of surveillance for vCJD, making it difficult to define and understand the intricacies of this new disease strain.

Consumer Perceptions and Hysteria of BSE

The rise of BSE throughout Europe has generated consumer fears about the safety of beef. Plus, the handling of BSE by the British government has resulted in consumer anger and distrust. It took the British government four years to take action to halt the spread of BSE and until 1996, 12 years after the discovery of BSE, to alert the public that there was a “probable link” between BSE and the new variant of CJD, hoping that the disease would not impact humans.

Although the British government banned the feeding of mammalian MBM to sheep and cattle, possibly contaminated feed could still be used for pig and chicken feed. However, the machinery used for cattle feed was also used to process pig and chicken feed. This machinery is difficult to clean, making it difficult to completely eliminate traces of beef byproduct from being fed to cattle.

While the 1988 Bovine Spongiform Encephalopathy Order sought to keep possibly contaminated beef byproduct from being fed to British cattle, the order made no provisions for exports. Banned cattle and cattle feed were exported to countries around

the world until 1996. Much of this feed went to developing nations and Asian countries have been estimated to have imported a million tons (Cowley).

In October 2000, a report of public inquiry ended with a 16-volume report detailing actions taken by the British government since BSE was first discovered and consumer perceptions of the ineffectiveness of these actions (Economist 2001a). Researchers have estimated that over 500,000 contaminated carcasses have entered the human food chain, much of which occurred before 1996 when the British government disclosed the severity of the BSE problem (Morris).

Consumers throughout the European Union are angered at the British government as well as their own governments for the slow response to protect the public health. Consumer hysteria goes beyond their anger for their governments' mistakes. The very nature of vCJD and the vagueness of the disease strikes fear in the minds and hearts of many consumers. Little is known about the causal agent of BSE and vCJD; only that one can contract the disease from contaminated beef products. The idea of possibly contracting a degenerative neurological disease from a food item generally regarded as safe invokes fear and uncertainty.

Much of the fear for BSE and vCJD also stems from characteristics of the disease. The disease is currently incurable and, even worse, untreatable. All that is known of vCJD is that the disease is a degenerative process where victims slowly lose control of their minds, then bodies. Another fearful characteristic of vCJD is the possible time the disease can take to incubate. Research has indicated that some individuals contain gene combinations that can prolong the incubation period of vCJD. For those with the more protective combination, the incubation period of vCJD is estimated to last 30 years before

the disease takes hold of its victim (Coghlan). Those who ate any beef products in England over the past decade must live with an every day fear that they could harbor a deadly disease without any ability of being diagnosed before the degenerative process begins.

Given the possibility of a long incubation time, there is a chance that vCJD may reach epidemic proportions over the next few decades. Researchers believe that a long incubation period could mean that over 100,000 people may eventually die from vCJD (MacKenzie). There is also fear that the disease may be present in the donated blood supply. Researchers removed blood from sheep infected with BSE and injected the blood into healthy sheep. In less than 2 years, one sheep began developing symptoms of a BSE-like disease, indicating that blood can be a transmissible agent (Young). Until scientists are able to give consumers more information, and a possible treatment and cure for the disease, consumer hysteria and fear will likely impact beef markets throughout the world.

Economic Implications

The outbreak of BSE has crippled beef industries throughout the world. Not only are nations with confirmed BSE unable to export beef, beef products, or live ruminants, they are also suffering financial loss from the destruction of cattle infected or thought to be infected with BSE. In 1995, before the announcement that there was a probable link between BSE and vCJD, the United Kingdom exported 77,000 metric tons of beef and veal around the world. In the year 2000, the UK was forecast to export less than 2,000 metric tons (USDA 2000c). As new cases of BSE are reported, exports will likely cease.

France and Germany have suffered heavily as well. In 1995, French beef and veal exports were 154,000 metric tons while their year 2000 forecast of beef exports was 55,000 metric tons. Germany's exports of beef and veal were forecast to fall from 212,000 metric tons in 1998 to 130,000 for the year 2000. Beef and veal exports for the EU were 934,000 metric tons in 1995 and fell to 640,000 in the year 2000. Reports of new cases of BSE in the EU will likely cause exports to fall even further.

Nevertheless, consumption of beef worldwide increased by 3% in 2000. While consumption has fallen off in some countries, beef consumption has increased in areas where BSE has not yet become an issue. North America, which has remained BSE free, has seen an increase of almost 1,000 metric tons in beef and veal consumption over the five-year period of 1995 to 2000 (USDA 2000b). Consumption of beef is most noticeably down in Europe and the former Soviet Union. In Europe, consumption of beef was estimated in early 2001 to be down by 28% of pre-1996 levels (Elliot). Eastern Europe has fallen off by over 12%. The overall increase in consumption suggests that many consumers worldwide still consider their beef supply to be safe.

In the UK, where efforts to keep BSE out of the food system began years before other European nations, consumption of roasts and steaks has increased. Evidence has shown that the concentration of BSE is higher in meat on the bone and nerve tissues, common components in ground beef and mince. Because of this, consumers throughout Europe have deemed ground beef and mince dangerous.

Beef consumption in France fell in the wake of their recent outbreak of BSE. By December of 2000, beef consumption in France had dropped by over 50%. As of February 2001, beef consumption began to rebound, but was still 24% lower than before

BSE was detected. Ground beef consumption decreased by 38% in January 2001 compared to the previous year. In order to combat this dip in consumption of ground beef, the French beef industry plans to launch a marketing program advertising their ground beef as “100% muscle” (Henard).

Germany has also seen a dramatic decrease in consumption since their recent breakout of BSE. Since December of 2000, beef consumption has been estimated to have fallen by 50%. In Germany, the sausage industry was heavily affected by the emergence of BSE. Beef off the bone and other highly infective beef components were finding their way into sausage. The government responded by banning beef in sausages. This did little to stop the fall in sausage consumption; however, later tests revealed trace elements of beef in sausage labeled beef-free (Achilles).

The crippling of the European beef industry has presented BSE-free nations with the opportunity to infiltrate export markets previously dominated by EU member states. The nations which appear to be taking most advantage of the BSE outbreak are the US, Canada, Brazil, New Zealand, and Australia. US beef exports are primarily high quality, grain-fed beef of which Japan is the largest importer. Increases of grain-fed beef from the US and Canada may increase slightly to replace EU exports. However, EU domestic demand for BSE-free, grain-fed beef may likely be the largest opportunity for BSE-free beef exporters. Several exporters, most notably the US, have issues such as hormone use that will limit sales.

Grass-fed beef exports, primarily from New Zealand and Australia, would likely benefit from the perception that BSE infection is extremely unlikely given that grass-fed cattle are never exposed to MBM in any form. Australia, however, has been developing

its grain-fed beef industry, which is targeted at the Japanese market. Australia has not imported MBM since 1966 and has not allowed MBM to be used for feed since 1997². MBM is not a major protein source for feed manufacturers in Australia since plant proteins are less expensive and readily available.

Food industries have been struggling with losses induced by BSE. Restaurants throughout Europe are decreasing the number of beef dishes on their menus or eliminating beef altogether. Alain Passard, a chef at the upscale restaurant L'Arpege in Paris, removed roasts and sweetbreads from the menu and replaced them with premium priced vegetable dishes (Woolridge). Sales throughout European McDonalds are down 3% from last year, and saw a 10% decrease in the last quarter of 2000 (McDonalds). Hoping to avoid a similar situation in the US, McDonalds of America set an April 1st, 2001 deadline requiring beef packers to include documentation proving that the cattle meet the Food and Drug Administration's standards on cattle feed (Burgdorfer). Rival Burger King has suffered losses as well. After profits fell by 6%, the fast food chain hired two advertising agencies in February 2001 to boost the company image in the wake of the BSE crisis (Mad-Cow 2001a). European meat wholesalers, who often supply restaurants, have seen demand fall off by as much as 40%. The impact of BSE has affected nearly every channel of the food industry in Europe. A German meat processing company, A. Moskel A.G., suffered a first half loss of \$1.4 million in 2000. In France, the market-leading slaughterhouse company, Socopa laid off 300 workers (Tagliabue).

In 1996, the EU banned the use of bovine material in non-food products. Before this, infected beef byproducts may have made their way into various non-food products

² Australia is both BSE and scrapie free.

such as cosmetics. Many of these products use processed bovine by-products such as collagen, elastin, gelatin, and tallow derivatives (BSE Inquiry).

Dietary supplements and medicines have historically used byproducts including components of bovine lung, heart, kidney, spleen, and brain (Cowley). More than 800 medicines throughout the world have been suspected to carry a risk of vCJD. In fall of 2000, an oral polio vaccine had to be recalled in England after it was determined that the vaccine used a serum that could have potentially been infected (Mad-Cow 2001b).

World Beef Implications

A poll taken in January 2001 found that approximately 45% of French consumers have altered their consumption of beef. Consumers were found to have substituted lamb, pork, poultry, and horse-meat for beef. Of that 45%, 12% had completely eliminated beef from their diets (Henard). An opinion poll done by German media revealed that 4% of German consumers had removed meat from their diet and may have contributed to a sharp increase in consumption of cheese products in December. Consumers have also turned towards organic foods (Achilles).

In 2000, the EU mandated a beef labeling system. This detailed labeling system must indicate the country of slaughter, the country of deboning, and a reference code of the animal. By January 2002, the labeling system will expand to specify the country of birth, fattening and slaughter of the animal (Hommezz). The EU also enacted plans to slaughter over 1.2 million cattle in efforts to eradicate BSE and eventually stabilize EU beef markets (Dong).

Since the rise of BSE, the cost of emergency measures, such as animal slaughter, to the EU has been approximately \$918 million (Economist 2001b). The most

devastating effect of BSE may still be in developing countries. After Britain banned the use of mammalian feed in their own food chain, they still exported tainted mammalian feed to the rest of the world. If BSE breaks out in the developing world, it is doubtful that nations in Africa or Asia would have the financial resources to destroy infected cattle. Lacking resources, a BSE breakout could mean a long-term collapse of beef markets among the developing world, as richer countries would refuse to buy any of their beef products. Any long-term collapse of beef markets in developing nations would set their development behind as innumerable jobs would be lost (New Scientist)

Looking Forward

For any nation to remain BSE free, the respective beef industry and government must be aggressive in their monitoring of a possible BSE outbreak. Any possibility of BSE must be dealt with quickly and efficiently. Aggressive investigation is exemplified by recent events in the United States. In late March 2001, the US government seized a flock of sheep in Vermont after fears arose that the sheep had contracted a version of BSE from feed consumed by their ancestors. The flock of sheep originated from Belgium in 1996 (Ring). Despite negative press and emotional reactions, the seizure was deemed necessary by the US government as a measure to keep the threat of BSE out of their food system.

Nations must also evaluate their feed system for BSE risks and work to remove any possible threat. Currently, MBM is still being used for poultry and pig feed throughout the world. There has been no evidence that BSE can infect poultry or pigs but what has been clear about BSE is that it does pose a threat across species barriers. Mice have been infected with BSE, a Siamese cat became infected from tainted pet food, and

over 80 humans have died from vCJD. The safest action to take would be to eliminate MBM from all animal feeds. Feather, linseed, and cottonseed meal has been shown to be an adequate alternative source of protein (Diven). Removing MBM from feed could prove to be too costly for many developing nations. The German Association of Feed, which stores nearly two thirds of all animal feed in Germany, estimates the cost of replacing MBM feed in Germany to be \$95 million. The value of the 65,000 tons of stored feed is only \$45 million (Dong). Since the removal of MBM feed is costly, nations relying on MBM can evaluate new rendering possibilities.

Recently an Australian company by the name Australian Dehydration Technologies (ADT) announced their development of a new BSE free, environment-friendly rendering process. The new rendering process attempts to create chemical and other necessary conditions for destroying the functionality of proteins. Another beneficial characteristic of the new process is that it is said to be less capital intensive (Feedstuffs). The system has approval from the Australian Environmental Protection Agency and ADT is currently in the patent protection process.

Nations affected by BSE must also work aggressively to rebuild consumer confidence. The recent plan by the EU to initiate a detailed labeling system is a strong step towards rebuilding consumer confidence. Governments threatened by BSE must make all relevant information readily available and must communicate to the public often. This would alleviate consumer distrust in their governments by eliminating any speculation of secrecy.

Governments throughout the world must bear the burden of risk by constantly improving their monitoring systems, and reviewing all production options to keep BSE

out of their food system. The problem of BSE clearly needs zero tolerance treatment in government policy and food industry practices. Any slippage in BSE policy could lead to new outbreaks of this pervasive disease.

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