

Director's Digest

FATS AND PROTEINS RESEARCH FOUNDATION, INC.



DR. GARY G. PEARL D.V.M.
Director Technical Services

16551 Old Colonial Road
Bloomington, Illinois 61704
Telephone: 309-829-7744 FAX: 309-829-5147
#329
<www.fprf.org>

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Biodiesel and BSE

What Is Biodiesel?

Biodiesel is a fuel comprised of mono-alkyl esters of long chain fatty acids derived from vegetable oils and animal fats. It meets the requirements of ASTM D6751 and in its pure form is designated B100.

Biodiesel is a renewable fuel made from any vegetable oil or animal fat and produced using either the transesterification or esterification oleochemical processes. After the chemical reaction occurs, the methyl esters are purified to remove insoluble impurities and glycerine.

What Is BSE and vCJD?

BSE is the acronym for Bovine Spongiform Encephalopathy, a degenerative disease of cattle affecting the central nervous system. BSE belongs to a group of transmissible spongiform encephalopathies (TSEs) that cause sponge-like abnormalities in brain cells. Some TSEs affect animals and others affect humans.

Many scientists believe these diseases are related to abnormal prion activity found in the cells of the central nervous system and other tissues. A prion is an infectious particle that differs from bacteria, viruses, fungi, viroids and plasmids. It consists of one protein, is resistant to inactivation by most procedures (such as heat) that destroy biological agents.

BSE is primarily found in the United Kingdom and other European countries. Although, on

December 23, 2003, the USDA reported that it had found one case of BSE in a Washington State dairy cow imported from Canada.

Research has indicated that there is a probable association between BSE and variant Creutzfeldt-Jakob Disease (vCJD). The human disease vCJD likely developed as a result of people consuming products contaminated with central nervous system tissue from cattle infected with BSE.

The Center for Disease Control (CDC's) monitoring efforts, in collaboration with state health departments, has not found evidence of indigenous cases of vCJD in the U.S. A probable case of vCJD was reported in spring 2002 in a British woman residing in Florida (NCBA, 2004).

Tallow Remains A Safe Feedstock For Biodiesel.

Tallow poses little risk of exposing BSE to humans. A European Union Scientific Steering Committee (SSC) opinion on tallow obtained from ruminant by-products (SSC, 2001) stated that "Normal industrial tallow production processes – even the one using the lowest time/temperature combinations – and corresponding research have shown to result in a product which is free from detectable TSE infectivity (injection into the brain of mice), even if the source material was highly infective."

This information is confirmed in BSE-spiked rendering studies where no infectivity was detectable in crude, unfiltered tallow produced by a rendering procedure that produced meat and bone meal with almost as much infectivity as was present in the untreated, BSE-spiked raw materials (Taylor et al., 1995; Taylor et al., 1997a; MAFF et al., 1997). The MAFF 1997 study showed that tallow can be considered safe even if its treatment does not achieve the 133°C/20 minutes/3 bars of pressure minimum standard.

Epidemiological studies have also failed to find any association between the occurrence of BSE and the consumption of tallow by cattle (Wilesmith et al., 1988; Taylor and Woodgate, 2003). The explanation of this result was considered to rest in the fact that because of the proteinaceous nature of the TSE agents, they would tend to remain with the cellular residues of meat and bone meal during the extraction process, rather than be extracted with the lipids of tallow (Wilesmith et al., 1988).

Oleochemical processes further reduce the infectivity risk of beef tallow. Chemical degradation processes of fat hydrogenation, catalytic transesterification and peptide bond hydrolysis resulted in risk factors for human consumption or skin application exposures as being lower than the background risk of contacting sporadic Creutzfeldt-Jakob Disease (CJD) (Appel et al., 2001).

Autoclaving at 121°C - 138°C or exposure to sodium hydroxide at room temperature are not completely effective for inactivation singly, inactivation can be achieved by combining these procedures (Taylor, 1997b). Esterification processes for methyl ester production produces heat of reaction of approximately 100°C and distillation associated with some processes approach 360°C. The use of acid or caustic catalysts provides pH ranges of 5 to 12 depending on the specific catalyst.

It should also be noted that feedstocks are filtered when entering the biodiesel production process, upon completion of the production process and at several points during the distribution chain. Though it is not exactly

known the risk reductions achieved by the filtering processes, the risk of protein impurities are significantly reduced.

Simulation Model Indicates Tallow-Based Fuel Poses Little Health Risk.

While it would be unrealistic to assume that tallow could never be contaminated with the BSE agent despite the evidence that the agent remains with the meat and bone meal during extraction, a study conducted at the University College in Dublin shows the risk of contracting variant Creutzfeldt-Jakob Disease from the exhaust of tallow used as a fuel is extremely small (Cummins et al., 2002). This study developed a simulation model to assess the infectivity risk to humans associated with potential airborne exposure to the combustion products when using tallow as a fuel in diesel engines.

Specific Risk Materials (SRM) were modeled for worst case infectious doses with an assumption that insoluble solids including protein material may remain in the tallow. SRM materials comprise those parts of an animal that present the greatest risk of BSE infectivity. The analysis of the risks associated with the combustion of tallow derived from SRM concluded that the risks are extremely small even when model uncertainty is taken into account (mean individual risk values¹ ranged from $10^{-11.43}$ to $10^{-7.23}$). The risks are a number of orders of magnitude less than the sporadic incidence of Creutzfeldt-Jakob Disease of approximately 10^{-6} . Based on current knowledge, the use of tallow as a fuel extender or for the manufacture of an alternative fuel such as biodiesel possesses negligible implications to human health.

One of the risk assessments included in the study was the assessment of the infectivity after combustion. While there were no reliable data available that determined the level of BSE infectivity in tallow in an internal combustion engine, it was assumed "that a similar action to

¹ Mean individual risk values indicate the risk of a person contracting a disease. For instance, a risk value of 10^{-6} for CJD indicates that the risk of contracting CJD is one person per million.

that used in a previous risk assessment for thermal disposal of material with a possibility of BSE infectivity could be expected" (Cummins et al., 2002). The combustion temperatures of diesel engines range from 800° to 1000°C.

The study referenced in the risk assessment by Cummins et al. was conducted for the United Kingdom's Environment Agency to determine the risks from BSE via environmental pathways as BSE-infected animals were disposed of. One of the disposal methods was incineration of the cattle and cattle products (DNV, 1997). For all of the disposal methods reviewed, "the results show that in one year the most exposed individual would be unlikely to consume, from environmental sources, more than a minute fraction – significantly less than one millionth part – of the dose of BSE infectivity needed to cause infection in humans."

Biodiesel Poses Little BSE-Related Health Risk

Biodiesel poses little BSE-related health risk to humans for several reasons.

1. The biodiesel production process purifies the methyl esters to eliminate insoluble products and other impurities.
2. During rendering, BSE prions tend to associate themselves with the protein materials rather than the tallow.
3. The infectivity risk to humans associated with potential airborne exposure to the combustion products when using raw tallow as a combustion fuel in diesel engines is negligible.

The possibility that humans could develop vCJD from the use of biodiesel is extremely small. In fact, the risk is exponentially smaller than the risk of contracting the naturally occurring TSE affecting humans, sporadic Creutzfeldt-Jakob disease.

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