

# A Quantitative Assessment of the Risk of Transmission of Bovine Spongiform Encephalopathy (BSE) by Tallow-Based Calf Milk Replacer

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## Summary

A Monte Carlo simulation model was constructed to assess the risk of BSE transmission to calves by tallow-based calf milk replacer (CMR). It was assumed that any BSE infectivity in the CMR would be associated with the allowable levels of impurities in tallow used to manufacture the CMR. Three different levels of impurities and six different distributions of the BSE infectivity titers of BSE infected CNS tissues were used in the model. In nearly all scenarios, the results suggest that tallow-based CMR could have been responsible for some BSE infections. Because of the uncertainty associated with the results obtained we do not believe that a more definitive statement should be made.

## Introduction

There is growing suspicion in some countries that CMR produced from tallow was associated with BSE transmission, although there is no experimental evidence that tallow from a BSE case contains BSE infectivity. However, in 2001, the Scientific Steering Committee (SSC) of the European Commission (EC) suggested that CMR containing tallow could be an explanation for the “maternal risk enhancement” factor needed in mathematical modelling of the BSE epizootic and some of the born after the real ban on RMBM (BARB) cases .

Seven of seven BSE cases diagnosed in Denmark in 2000-2001 were from dairies that fed CMR produced by a single German firm. Although feeding data for the individual animals is not available, investigations showed that the CMR was very likely fed to the affected animals. The possible exposure to MBM cannot, in any case, be ruled out. Further investigations revealed that the CMR in question contained edible fat (tallow) produced by the rendering (fat melting in Germany) of adipose tissues and the spinal column of cattle. The tallow was produced in Germany or imported from several countries now known to have BSE in their cattle populations.

The SSC stated that “in principle, tallow is safe after appropriate purification. But due to the documented possible presence of impurities, and depending end-use the raw material it should be obtained from appropriate sources (geographical, herd, animal and its age...) animal species and tissues”. In the same opinion, they suggested that it may be prudent to consider excluding tallow from the high fat milks fed to young calves whenever it is not produced according to the conditions required for the production of tallow for human consumption. In general, tallow fit for human

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consumption is produced from bones and discrete adipose tissues of animals fit for human consumption. The maximum level of impurities was set at 0.15% by Council Decision 1999/534/EC in 1999. Exclusion of specified risk materials (SRM) was required by the EC regulation 97/534/EC but this regulation was not adopted EC-wide until October 2000.

Kamphues et al., 2001 showed that tallow produced from a clinically BSE infected animal could potentially contain BSE infectivity if the raw material contained the skull and/or spinal column of BSE infected animal in the late stage of the incubation period. The BSE infectivity was assumed to be associated with the allowable levels of protein residues in the final fat product.

## **Methods**

We used the modified deterministic risk model of Kamphues et al. 2001 to construct a stochastic, probabilistic simulation model. We also expanded the model such that we could estimate the probability that a calf that was fed CMR made from BSE infected tallow would be infected with BSE and further, the probability that a BSE infected calf would become a detectable or clinical BSE case. We also estimated the number of calves that might be infected by one BSE infected batch of CMR and the total number of BSE cases that might be associated with one infected batch of CMR.

### *Model assumptions.*

- One clinical BSE case was used in production of one batch of tallow.
- The tallow in CMR was produced from discrete adipose tissues and spinal columns of cattle.
- BSE infectivity was associated with the allowable impurities in the tallow.
- The allowable impurities in tallow were 0.5%, 0.15% or 0.02%.
- The spinal cord weighed approximately 200 grams.
- The BSE infectivity in spinal cord was 1-1000 ID<sub>50</sub>/gram
- In an infected animal, the SRM contains 95% of the BSE infectivity.
- One batch of tallow was 20-25 tons.
- An entire batch of tallow containing BSE infectivity was used to produce CMR that was fed to calves.
- CMR powder contained 13.5-20.5% fat (tallow).
- The fat in CMR was 80% animal fat.
- One liter of CMR contained 120-140 grams of powder.
- Calves consumed 4.5 to 6.5 liters CMR per day
- Calves consumed CMR for up to 7 weeks after birth.
- A batch of tallow could be used to produce sufficient CMR to feed ca. 9500 calves.
- There is a linear relationship between the probability of infection and dose up to 2 ID<sub>50</sub> with an infection probability of zero at an exposure level of zero and an infection probability of 1 at an exposure level at 2 ID<sub>50</sub> or more.

- Approximately 10% of BSE infected cattle in Denmark live long enough to develop clinical or detectable BSE.

These assumptions were incorporated into a Monte Carlo simulation model as fixed values or probability distribution functions (PDF). Simulations with six different PDFs for infectivity titer/g of CNS tissue three levels of allowable impurities were run..

## Results and discussion

Our results are shown in Table 1. They suggest that milk replacer produced from BSE infected tallow could have accounted for some BSE cases. Some BSE cases were generated in almost all scenarios, the exception being in a scenario with 0.02% impurities, and a PDF based on the preliminary results of an ongoing dose response trial. It is likely that CMR produced before 2000 was produced from tallow melted from raw material containing SRM. The two primary sources of uncertainty were the distributions of the infectivity titer in CNS tissue and the levels of allowable impurities in the tallow. Sensitivity analysis showed that the infectivity/g of CNS material had the highest correlation with the probability of infection and the expected number of cases.

**Table 1.** Table showing the PDFs and 95<sup>th</sup> percentile values for the probability of infection in an individual calf and the number of BSE cases that might result from feeding CMR produced from one batch of infected tallow.

PDF	Probability of Infection			Number of BSE cases/Batch		
	Level of Impurities			Level of Impurities		
	0.50%	0.15%	0.02%	0.50%	0.15%	0.02%
Lognorm(262.5, 1352.9, Truncate(10, 1000))	0.2904	0.0902	0.0011	267	88	12
Lognorm(54.6, 24.1, Truncate(10, 1000))	0.0576	0.0179	0.0003	57	19	3
Lognorm(26.64, 65.78)	0.0507	0.0157	0.0003	49	15	3
Pert(1,50,1000)	0.2753	0.0851	0.0011	264	83	12
Pert(1,10,1000)	0.2514	0.0779	0.0010	242	76	1
Pert(0, 1.33, 8.8)	0.0029	0.0009	0.0000	17	6	0

## Reference

Kamphues, J., Zentek, J., Oberthür, R.C., Flachowsky, G., Coenen, M., 2001. Futtermittel tierischer Herkunft als mögliche Verbreitungsursache für die bovine spongiforme Enzephalopathie (BSE) in Deutschland: 1. Mitteilung: Vergleichende Risikobewertung der Einzelfuttermittel tierischer Herkunft. Dtsch.Tierärztl. Wschr. 108, 283-290.