An investigation of candidate factors affecting the quality of Bovine Spongiform Encephalopathy (BSE) Rapid Test Laboratory samples taken at a beef slaughterhouse

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Introduction

Regulation (EC) 999/2001[a] as amended requires that all healthy slaughtered bovines over the age of 72 months be tested for the presence of BSE. The first stage of TSE testing is sampling. In order to ensure the integrity of test results it is vital that the most appropriate tissue is obtained[b]. The area which should be sampled is the tissue where abnormal PrP is most consistently deposited, and co-incidentally first detectable. For BSE, the pattern is remarkably consistent, with early changes appearing first in certain nuclei in the brainstem at the level of the obex. The correct sample is outlined in Figure 1[c]. Occasionally suboptimal samples (SO) occur where the sample is either too small, not from the correct area of the brain stem or the tissue needed for confirmation is damaged[d]. In such circumstances positive results are always valid, however, negative results are questionable and may have an implication for the safety of meat from the respective animals.

Methods

A stepwise logistic regression analysis was conducted using SPSS (IBM, Chicago, USA) to predict SO occurrence on 23,646 animals sampled between 09/06/2009 and 30/06/2011 using animal age at slaughter, breed category, gender, dehiding method and sampler identity as predictors. Age, breed and gender of each animal were obtained from AIM – the national Animal Identification and Movement database. Sample optimality and sampler identity information was obtained from the Rapid Test Laboratory Reports. The slaughterhouse changed its dehiding method from an upward to a downward method mid study on 27/10/2009. Cattle breeds were categorised as indicated in Table 1.The logistic regression model can be represented as follows:

$$Logit(p) = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + \ldots\ldots\ldots\ldots\ldots + b_kx_k$$

b_0, b_1, b_2, .. b_k being the regression coefficients of the predictor variables x_1, x_2.... x_k. An predictor variable with a regression coefficient not significantly different from 0 ($p>0.05$) can be removed from the regression model. If $p<0.05$ then the variable contributes significantly to the prediction of the outcome variable. The odds ratio is computed by raising **e** (= 2.71828) to the power of the logistic coefficient.

Table 2 - Logistic Regression Analyses

	B	S.E.	Wald	df	Sig.	OR	95% CI for OR Lower	95% CI for OR Upper
Breed			9.140	2	.010			
Native Breeds	.825	.345	5.726	1	.017	2.283	1.161	4.487
Continental Breeds	.859	.306	7.859	1	.005	2.360	1.295	4.300
Sampler			44.787	12	.000			
S_AHLMK	1.777	.580	9.375	1	.002	5.912	1.896	18.440
S_BMINCW	-14.785	2706.830	.000	1	.996	.000	.000	.
S_DLRKL	1.261	.558	5.103	1	.024	3.528	1.182	10.536
S_EMADA	1.658	.490	11.468	1	.001	5.250	2.011	13.709
S_GSDRO	-14.891	5183.304	.000	1	.998	.000	.000	.
S_JBNCW	.694	1.083	.410	1	.522	2.001	.239	16.728
S_LHABB	-.286	.466	.375	1	.540	.752	.301	1.874
S_MCASK	-15.063	2271.746	.000	1	.995	.000	.000	.
S_RFRKL	.664	1.086	.374	1	.541	1.944	.231	16.338
S_RSBAL	-14.899	4297.466	.000	1	.997	.000	.000	.
S_SNNCW	-15.013	3310.606	.000	1	.996	.000	.000	.
S_TBADA	.315	.557	.321	1	.571	1.371	.460	4.087
GENDER	.991	.342	8.391	1	.004	2.693	1.378	5.266
Constant	-6.795	.443	235.666	1	.000	.001		

Table 3 - Prediction success of the model

Observed		Predicted SO 0	Predicted SO 1	Percentage Correct
SO	0	17106	6478	72.5
	1	19	43	69.4
Overall Percentage				72.5

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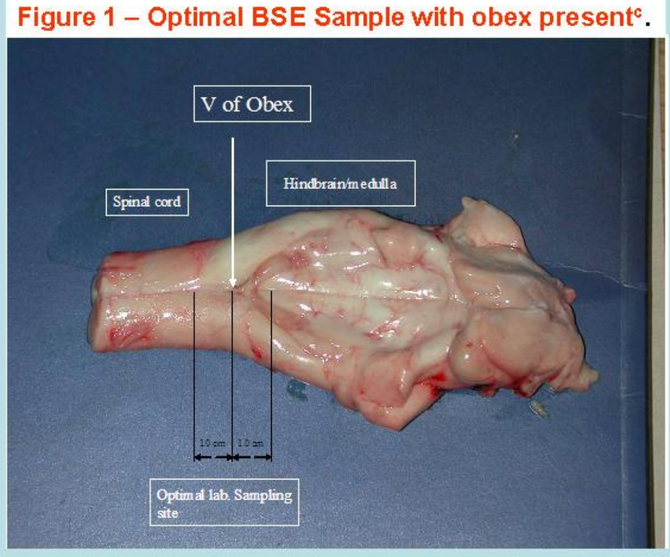
Objectives

This study investigates the relationship between SO occurrence and animal age, breed category (see Table 1), gender, dehiding method (upward or downward) and sampler identity (n=13).

Figure 1 – Optimal BSE Sample with obex present[c].



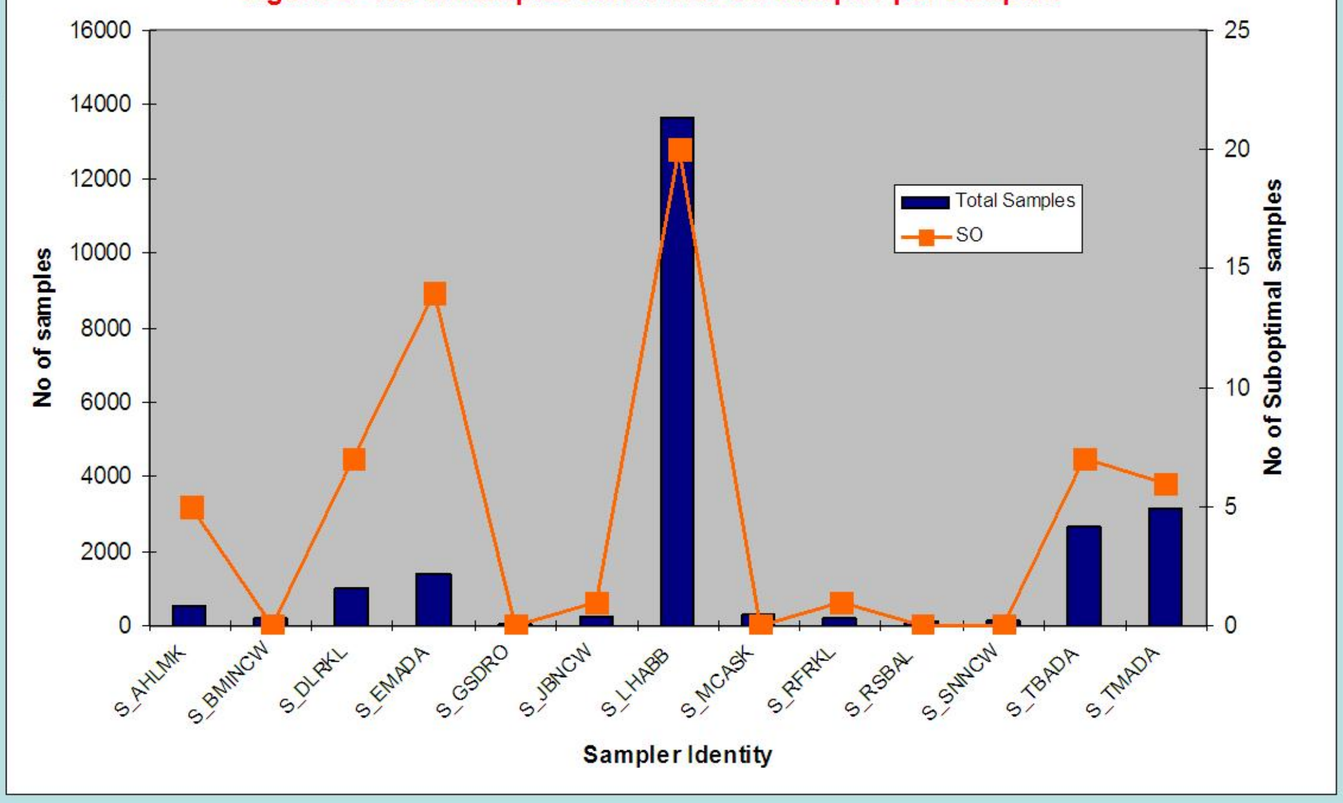
Category	Breeds	Frequency
Native Beef Breeds	Aberdeen Angus, Hereford, Galloway	3898
Continental Breeds	Charolais, Simmental, Limousin, Belgian Blue, Saler, Blonde d'Acquitaine, Montbelliarde, Aubrac, Piedmontese	5676
Dairy Breeds	Friesian, Ayrshire, Dexter, Kerry, Jersey, Guernsey, Shorthorn	14072

Table 1 – Categorisation of Breeds

Results

The incidence of SO samples in the current slaughterhouse was 0.26% (n=68). Samples were taken by 13 samplers. The number of samples taken and SO attributed to each sampler are outlined in Figure 2. Table 2 outlines the output of the SPSS logistic regression analysis. A test of the full model against the constant only model was statistically significant indicating that the predictors as a set reliably distinguish between SO and optimal results (Chi-squared = 66.356, $p<0.05$, df = 15). Prediction success overall was 72.5% (Table 3). The Wald criterion demonstrates that three samplers [S_{ahlmk}, S_{dlrkl} and S_{emada}], male animals and beef breeds made a significant positive contribution ($p<0.05$) to SO occurrence. Odds ratios (OR) for each predictor - S_{ahlmk} (OR=5.9; 95%CI=1.9-18.4), S_{dlrkl} (OR=3.5; 95%CI=1.2-10.5), S_{emada} (OR=5.3; 95%CI=2.0-3.7), bulls (OR=2.7; 95%CI=1.4-5.3), native beef breeds (OR=2.3; 95%CI=1.2-4.5) and continental beef breeds (OR=2.4; 95%CI=1.3-4.3) indicate the factors by which the likelihood of SO occurrence increases when the predictor in present. Age and dehiding method were found not to be significant contributing factors to SO occurrence.

Figure 2 - No of samples taken with SO sampler per sampler.



Significance of Study

The results inform a basis for risk ranking animals according to breed and gender prior to sampling. The results also emphasise the importance of sampler training and motivation. As animal age is not a significant contributing factor samplers are encouraged to perfect their technique by sampling animals younger than the statutory prescribed age (currently 72 months) prior to taking official samples from older animals. Figure 2 demonstrates that SO occurrence is not necessarily a function of sampler experience (as measured by number of samples taken) – those samplers taking fewer samples often not taking any SO samples. This highlights the need to address motivation amongst regular samplers.

References

[a]Regulation (EC) 999/2001 (2001) Available: http://ec.europa.eu/food/fs/bse/bse36_en.pdf

[b]Veterinary Laboratories Agency (2006) Available: http://vla.defra.gov.uk/science/docs/sci_tse_rl_spinal.pdf

[c]Simmons & Webster (2005) Available: http://vla.defra.gov.uk/science/docs/sci_tse_rl_samp_iss.pdf

[d]Department of Agriculture, Food and the Marine (Ireland) (2011) Standard Operating Procedure – BSE Controls in Slaughterhouses. Dublin, Ireland.