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THE EFFECT OF AGE ON THE INFECTION OF FEMALE BEEF CATTLE WITH BOVINE PESTIVIRUS

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Infection of cows with pestivirus during the first four to six months of pregnancy can result in an increased rate of embryo-foetal death, birth of persistently viraemic calves, which may subsequently succumb to mucosal disease, and birth of calves with various developmental abnormalities (Littlejohns and Horner, 1990; Meyling et al., 1990). The timing of infection is therefore important in determining the affect of bovine pestivirus on herd reproductive performance. For dairy cattle, a number of studies have shown an increasing seroprevalence with age (Harkness et al., 1978; Houe and Meyling 1991; Løken et al., 1991). However, no studies have apparently been undertaken on the association of age and infection of beef cattle. This paper reports the results of such a study undertaken on female beef cattle in central Queensland, Australia.

MATERIALS AND METHODS

Stored sera previously collected from cattle in Queensland were used in this study (Ward, unpublished data). Serum samples from central Queensland female beef cattle | 4 years of age were selected for inclusion. Ten to thirty serum samples were selected per herd studied. All selected serum samples were tested with a gel diffusion precipitin (GDP) test for exposure to bovine pestivirus (Littlejohns and Snowdon, 1980). Results were read as negative, 1+, 2+ or 3+.

Age of cattle was categorised as 0-2, 2-3, and 3-4 years. The association between age and bovine pestivirus infection was investigated using logistic regression modelling techniques (Hosmer and Lemeshow, 1989). Age was initially entered as a categorical variable in an ordinary logistic model, using the above categories (BMDP Statistical Software, version PC90, Los Angeles, 1990). A polychotomous logistic regression model was investigated using the dependent variable, GDP test result, as a pseudocontinuous variable. The association between bovine pestivirus exposure and age was also examined using age as a continuous variable.

RESULTS

A total of 400 cattle in 20 herds met inclusion criteria for the study. One hundred and sixteen cattle were aged 0-2 years, 194 cattle were aged 2-3 years, and 90 cattle were aged 3-4 years. The overall bovine pestivirus seroprevalence was 51.25%. Age-specific pestivirus seroprevalence estimates for cattle 0-2, 2-3 and 3-4 years were 43.97, 43.30 and 77.78% respectively.

Results of logistic regression modelling using an ordinary logistic regression model are shown in Table 1. Using the age group 0-2 years as the reference group, the odds of a test positive result was not found to be significantly ($P > 0.05$) different from 1.0 for cattle 2-3 years of age, but was significantly ($P < 0.05$) greater than 1.0 for cattle 3-4 years of age.

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Table 1. Exponentiated coefficients and 95% confidence intervals for an ordinary logistic regression model fit to a data set with bovine pestivirus gel diffusion precipitin (GDP) test as the outcome of interest.

variable	coefficient	95% confidence interval
constant	0.79	0.54 - 1.13
age (2-3 years)	0.99	0.62 - 1.57
age (3-4 years)	4.46	2.40 - 8.29

Results of logistic regression modelling using a polychotomous logistic regression model are shown in Table 2. Using test result as an ordinal variable (negative, 1+, 2+, 3+) gave similar results to that of the ordinary logistic regression model. The odds of a test positive result was found to be significantly greater ($P<0.05$) than 1.0 for cattle aged 3-4 years compared to cattle aged <2 years.

Table 2. Exponentiated coefficients and 95% confidence intervals for a polychotomous logistic regression model fit to a data set with bovine pestivirus gel diffusion precipitin (GDP) test as the outcome of interest.

variable	coefficient	95% confidence interval
constant (negative)	0.92	0.64 - 1.30
constant (negative, 1+)	0.68	0.47 - 0.99
constant (negative, 1+, 2+)	0.24	0.16 - 0.35
age (2-3 years)	0.89	0.57 - 1.40
age (3-4 years)	2.20	1.30 - 3.60

Since the relationship between age and bovine pestivirus test result appeared to be quadratic on a logistic scale, age was entered into a polychotomous logistic regression model as a continuous variable. The following category midpoints were used: 1.0, 2.5, 3.5 years. A quadratic term for age was included in this model. The relationship between age, measured in years, and bovine pestivirus GDP test result for all outcomes (1+, 2+ and 3+) was found to be described by equation 1. Both age and its quadratic term were statistically significant ($P=0.011$ and 0.002 respectively).

$$odds = e^{0.9654 - 1.4390 (age) + 0.3885 (age^2)} \qquad (1)$$

DISCUSSION

The significant increase in odds of a bovine pestivirus GDP test positive result for female beef cattle aged 3-4 years found in all models has implications for possible reproductive loss in beef cattle herds in central Queensland. Since many first and possibly second-calf heifers in this region have not been exposed to bovine pestivirus and are therefore susceptible to infection at some time during pregnancy, reproductive failure can be expected to occur. Reproductive loss in cattle infected with bovine pestivirus around the time of conception has been demonstrated in clinical trials (McGowan et al., 1993), and this observational study confirms that a potential for reproductive loss in beef cattle herds exists.

Bovine pestivirus transmission within a herd may occur by *in utero* infection and birth of persistently viraemic calves, or by direct contact. Extensive beef cattle management reduces the risk of exposure of cattle to pestivirus. Exposure is known to be increased by regular yarding of cattle, as occurs in dairy cattle management systems and in artificial insemination programs (McGowan et al., 1993). The higher than expected odds of exposure of cattle 3-4 years old with pestivirus may be explained by management factors, such as artificial insemination programmes. If this is the case, epidemics of infection in these programs may be responsible for poor conception rates. Efforts to prevent infection in these groups of beef cattle, or exposure at an earlier age, could be beneficial.

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