ENVIRONMENTAL FACTORS INFLUENCE THE PREVALENCE OF INFECTIOUS BRONCHITIS VIRUS

J.C. LOPEZ† and R. MCFARLANE†

Summary

Binary logistic regression analyses were conducted to assess associations between the presence of infectious bronchitis virus (IBV) in broilers and various risk factors: ambient ammonia, oxygen, carbon dioxide, humidity and litter humidity. Pairs of sheds were selected from ten large broiler farms in Canterbury, New Zealand. One shed from each of the pairs had a production or health alteration that suggested the presence of IBV and the other was a control shed. IBV was detected by RT-PCR in 50% of the farms. In 2 of the 5 positive farms where IBV was detected there were accompanying clinical signs that suggested infectious bronchitis (IB). More commonly uncomplicated infections with IBV were asymptomatic under good management. Ambient humidity was the only risk factor that showed an association (inverse) with the prevalence of IBV.

I. INTRODUCTION

Infectious bronchitis (IB) is a highly contagious respiratory viral disease of chickens characterized by respiratory and renal pathology, a drop in egg production and egg quality in layers and decreased growth and feed efficiency in broiler chickens (Cavanagh and Naqi, 2003). Infectious bronchitis virus was first isolated in New Zealand by Pohl (1967) and was subsequently shown to be serologically different from other international strains (von Bülow, 1969; Lohr, 1977). A high prevalence of IBV has been demonstrated recently in New Zealand using RT-PCR (Ramneek et al., 2005); 28 genotypes differed from other international strains.

Seasonal cycles of infectious diseases have been attributed to environmental changes, pathogen appearance and disappearance and host-behavior changes (Dowell, 2001). Many diseases caused by coronavirus such as severe acute respiratory syndrome (SARS) and infectious bronchitis (IB), exhibit winter seasonality with the presence of persistent virus carriers (Dowell and Ho, 2004). The prevalence of respiratory diseases peaks during winter in poultry farms and could be caused by ineffective ventilation because of the desire to conserve heat. Reduced ventilation usually results in an increase in air pollutants, such as ammonia, carbon dioxide, dust and air-borne microorganisms (Anderson et al., 1966).

Certain factors are known to reduce bird performance, exacerbate clinical disease or modulate immune response: low/high environmental temperatures (Ratanasethakul and Cumming, 1983), humidity levels (Yoder et al., 1977), high ammonia levels (Anderson et al., 1964), and low levels of oxygen (Olander et al., 1967). Only a few of these factors have been studied in relation to an IBV infection. The aim of this study was determine the prevalence of IBV in broilers within the Canterbury province in late winter and search for associations with management or environmental factors.

† Agriculture and Life Sciences Division, PO Box 84 Lincoln University, Canterbury New Zealand
II. MATERIALS AND METHODS

a) Farm Selection

The farms eligible for the case control study were suppliers for a major broiler producer in Canterbury, New Zealand. Ten farms (the average size was 77,000 birds) were selected from a total of 29 farms that produced approximately 60-70% of the broiler chickens from Canterbury. Birds from these farms in the past have contained high levels of antibodies against IBV or exhibited productive problems. Birds within one of the sheds had some production or health signs that suggested the presence of IBV, or were known to have experienced clinical infectious bronchitis (IB) in the past. This shed was defined as the case shed and the control shed was defined as the shed believed not to contain birds that had been affected by IB.

The flock in each shed had a high degree of similarity with respect to the age of birds, number of drinkers, nature of food and litter.

b) Detection of IBV

In each shed, 6 birds were randomly selected. Each bird was examined for respiratory signs and tracheal and cloacal swabs were taken, placed in transport media (Poulvac Sterile diluent, Fort Dodge Animal Health, USA) with antibiotic (Enrofloxacin 10%, Bayer, New Zealand) and stored at -20°C. RNA was extracted by the addition of TRIzol (Life Technologies, USA) and IBV was detected using the RT-PCR assay, as described by Ramneek et al. (2005). The levels of ammonia, oxygen, carbon dioxide, and ambient humidity, 0.5 m above the litter surface, were measured using a Draeger multigasm II gas detector (Dräger AG, Lübeck, German). Litter humidity was measured by manual compression (North and Bell, 1990).

c) Questionnaire and Data Analysis

A questionnaire was completed by the farm manager in order to collect information about certain farm characteristics; such as, flock size, management practices and environmental factors. A descriptive analysis was completed to provide summary statistics for all variables in the data set. Binary logistic regression analyses were conducted to assess associations between presence of IBV and various risk factors, using MINITAB Statistical Software (Minitab Inc, Pennsylvania, USA).

III. RESULTS and DISCUSSION

There is a general belief that IBV infection in broilers in New Zealand is under-diagnosed, particularly as its prevalence has been largely based on seroconversion and this may be misleading as birds are frequently tested at slaughter (35-40 days old) and have had little time to seroconvert, thus leading to false negatives. A study made by Ramneek et al. (2005) showed that 19% of the New Zealand broilers and layers were positive to IBV, as detected by direct RT-PCR. In this study, IBV was detected by RT-PCR in birds from 50% of the farms. In 2 of the 5 positive farms where IBV was detected there were accompanying clinical signs of IB. The lack of clinical disease in the field where IBV was present could be attributed to a number of factors, including: mildness of the IBV strains, good management practices and the absence of immunosuppressive agents such as infection bursal disease virus, chicken anemia virus, Mycoplasma gallisepticum, E. coli, or Haemophilus paragallinarum. These agents have been rarely found in New Zealand and the resulted pathology due to them is mild (Brooks, 2003). Ramneek (2000), studied the pathogenicity of 5 different genotypes of IBV and found that all the strains analysed induced only mild histological lesions and clinical
signs. This study was carried out under good management conditions with respect to temperature, humidity and levels of ammonia).

Environmental changes are the explanation most often used to explain the seasonality of infectious diseases (Dowell, 2001) and most avian respiratory pathogens exhibit an annual increase in incidence each winter. The temperature was higher than 24°C in only 2 farms, but otherwise was within the optimum temperature for birds at 19°C to 24°C (Yoder et al., 1977). A reduction in ambient temperature (constant 16°C) has been reported to increase mortality in IBV infections (Cumming, 1969). There were no indications (postural adjustments, behavioural changes, or changes in food and water consumption) that the birds were uncomfortable with the ambient temperature.

In this trial we found a significant inverse relationship (P = 0.05; OR = 0.92) between the prevalence of IBV and ambient humidity (Table 1). Yoder et al. (1977) reported that at medium temperatures (19-24°C) and low humidity, flocks infected with Mycoplasma synoviae and IBV had a higher incidence of airsacculitis than at a high humidity. It has been proposed that drying of mucosal surfaces increases the probability of bacteria colonisation (Dowell, 2001). In humans, outbreaks by respiratory syncytial virus (RSV) have been reported to peak in seasons of lower relative humidity (Chew et al., 1998). However, Itjaz et al. (1985) studied the survival of airborne human coronavirus and reported that a high relative humidity (80 +/- 5%) at 20 +/- 1°C, was found to be least favourable for the survival of virus aerosols.

Table 1. Logistic regression analysis of factors associated with the presence of IBV in broiler farms

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>P Value</th>
<th>OR</th>
<th>95% CI</th>
<th>Mean (Range)</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature*</td>
<td>0.99</td>
<td>1.0</td>
<td>0.74-1.35</td>
<td>22.5°C</td>
<td>0.720</td>
</tr>
<tr>
<td>Humidity*</td>
<td>0.05</td>
<td>0.92</td>
<td>0.84-1</td>
<td>75.3%</td>
<td>3.490</td>
</tr>
<tr>
<td>Ammonia*</td>
<td>0.4</td>
<td>1.03</td>
<td>0.96-1.1</td>
<td>16.7 ppm</td>
<td>3.100</td>
</tr>
<tr>
<td>Oxygen*</td>
<td>0.25</td>
<td>0.07</td>
<td>0.0-7.4</td>
<td>20.4 %</td>
<td>0.054</td>
</tr>
<tr>
<td>Carbon dioxide*</td>
<td>0.8</td>
<td>0.69</td>
<td>0.01-60.39</td>
<td>0.31%</td>
<td>0.040</td>
</tr>
<tr>
<td>Litter humidity</td>
<td>0.1</td>
<td>4.6</td>
<td>0.74-28.47</td>
<td>2.6 (1.0-3.5)</td>
<td>0.220</td>
</tr>
</tbody>
</table>

OR= Odds Ratio, CI= Confidence interval, SEM= Standard error of the mean
* Measured 0.5m above litter surface.

Based on the results of previous studies (Anderson et al., 1964; Kling and Quarles, 1974) it was anticipated that higher levels of ammonia could increase the presence of IBV or exacerbate the clinical signs found in infected birds. Anderson et al. (1964) reported that 72 hours of exposure to ammonia concentrations in the range of 20 to 50 ppm significantly increased the infection rate of chickens with Newcastle disease virus when given as aerosol. However, no association was found in this study. Four of the six sheds positive for IBV had low ammonia levels (under 20 ppm).

Levels of oxygen and carbon dioxide in the poultry industry are used principally as criteria for an efficient ventilation system. Although 55% of the sheds in our studies had a
low level of oxygen (under 20.5 %) and 40% had high levels of carbon dioxide (over 0.3 %), we did not find a significant association between the levels of oxygen or carbon dioxide and the detection of IBV.

In this trial, there was no significant relationship between the litter humidity and IBV occurrence. Indeed in the majority of the of the sheds positive for IBV, levels of litter humidity were higher than recommended (North and Bell, 1990).

We can conclude with the constraints of the similar management systems described, that humidity has an influence on the presence of IBV, but there was no influence due to temperature, ammonia, carbon dioxide, oxygen and litter humidity.

REFERENCES

Ramneek. (2000). Typing of infectious bronchitis virus (IBV) and relationship to protection in poultry. A thesis submitted in partial fulfilment of the requirements for Degree of Doctor of Philosophy at Lincoln University, New Zealand