Infectious bursal disease in Ethiopian village chickens

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Poultry production in Ethiopia and Infectious bursal disease virus (IBDV)

- The majority of Ethiopian poultry are indigenous birds kept in small backyard flocks, belonging to rural smallholders, and are particularly important to landless in society, and also to women.
- Disease is reported by smallholders to be a major constraint to production, but most outbreaks are attributed to Newcastle disease without any investigation of the pathogens responsible.
- IBDV was first reported in Ethiopia in 2002 in a commercial flock, but the very virulent (vvIBDV) strain type has since been identified in all production systems. This strain is associated with high mortality in birds between 3 and 6 weeks of age.
- Only birds over 3 weeks and less than around 10 weeks of age will have clinical disease (diarrhoea, dehydration, erythemic haemorrhages). Adult birds will seroconvert without showing clinical signs. Chicks under 2 weeks do not normally develop disease, but become immunosuppressed, as the developing B cells are depleted by the virus, impairing the bird’s ability to produce antibodies.

Modelling risk factors

- Multi-level intercept only models were fitted to assess the variation in antibody levels (as measured by the S:P ratio) at each level of the dataset, and the amount of variation between different ELISA plates.
- Intraclass clustering coefficients indicated “66% of variation was contributed by individual birds, and ~13% by the farm. Market shed and region did not contribute significantly. However, the ELISA plate was an important source of variation. Household and plate were therefore fitted in the final multilevel mixed model as random effects, and village and season were included as fixed effects.
- Other household and bird level variables were screened for inclusion in the final model, and retained where there was evidence that they significantly (p<0.05) improved model fit (Table 1.).
- Due to the non-normality of the residuals, bootstrap estimates of the standard errors (SE) were estimated. The simulated SE’s were lower for the effects of Salmonella titre and outbreak history and only slightly increased for the village effect without altering the significance, providing evidence that our estimates are generally robust, despite non-normality. However, the bootstrapped model suggested that Season B was not significantly different to the other seasons (p=0.09).
- Bird-level residuals were examined for spatial clustering, by comparing them with simulated sets of residuals with no spatial correlation. The variogram shown below suggests that, in adjacent villages H1A and H1B, in Season D, there was more similarity between birds found close to each other, as we might expect with an infectious agent. However, spatial clustering of residuals was not evident for all villages in all seasons.

Table 1: Fixed effects

<table>
<thead>
<tr>
<th>Term</th>
<th>Coefficient</th>
<th>SE</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Season A</td>
<td>0.000</td>
<td>0.018</td>
<td>0.028</td>
</tr>
<tr>
<td>Village H1A</td>
<td>0.031</td>
<td>0.027</td>
<td>0.242</td>
</tr>
<tr>
<td>Village H1B</td>
<td>0.055</td>
<td>0.027</td>
<td>0.045</td>
</tr>
<tr>
<td>Village H2A</td>
<td>0.064</td>
<td>0.027</td>
<td>0.020</td>
</tr>
<tr>
<td>Village H2B</td>
<td>0.070</td>
<td>0.026</td>
<td>0.006</td>
</tr>
<tr>
<td>Village J1A</td>
<td>0.094</td>
<td>0.030</td>
<td>0.082</td>
</tr>
<tr>
<td>Village J1B</td>
<td>0.055</td>
<td>0.029</td>
<td>0.012</td>
</tr>
<tr>
<td>Village J2A</td>
<td>0.116</td>
<td>0.029</td>
<td>0.000</td>
</tr>
<tr>
<td>Village J2B</td>
<td>0.056</td>
<td>0.024</td>
<td>0.516</td>
</tr>
<tr>
<td>No outbreak in last 12 months</td>
<td>0.059</td>
<td>0.026</td>
<td>0.022</td>
</tr>
<tr>
<td>No outbreak in growers</td>
<td>0.097</td>
<td>0.043</td>
<td>0.025</td>
</tr>
<tr>
<td>Outbreak in adults</td>
<td>0.011</td>
<td>0.012</td>
<td>0.372</td>
</tr>
<tr>
<td>Outbreak in chicks and adults</td>
<td>0.001</td>
<td>0.025</td>
<td>0.978</td>
</tr>
<tr>
<td>Outbreak in growers and adults</td>
<td>0.046</td>
<td>0.028</td>
<td>0.162</td>
</tr>
<tr>
<td>Outbreak in all age groups</td>
<td>-0.003</td>
<td>0.021</td>
<td>0.879</td>
</tr>
</tbody>
</table>

Conclusions

- Infectious bursal disease is or has been circulating in at least seven out of the eight villages in our study.
- The association of seropositivity in a household flock with recent deaths in growers, but not chicks or adults fits with the biology of the disease, and is consistent with IBDV contributing to mortality in this population.
- All seropositive birds had moderate to high antibody levels to Salmonella, which makes it unlikely that they were infected as chicks. It is probable that all immunosuppressed birds have died by the age of 6 months.
- The differences between and possibly within villages highlights the need for control strategies to be tailored to the local area, with regard to regional differences in the socio-economic importance of poultry, rather than blanket measures applied.

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Optical density is converted to a ratio to the positive control (S:P ratio). Birds with an S:P ratio > 0.285 are considered seropositive

1180 birds tested antibody negative
44 birds tested antibody positive

Distribution of S:P ratios. An S:P ratio of 0.285 equates to an antibody titre of ~2400

Sampling Methods

Data was clustered at 4 levels

2 Regions (Horro & Jarso) Both in highland areas, but with different social demographics

4 Market sheds (groups of villages dependent on a single market)

Each village was visited 4 times, and different households were randomly selected

640 households H1A H1B H2A H2B J1A J1B J2A J2B Total
May 2012 15 15 15 15 15 15 15 15 120
Oct 2012 15 15 16 15 15 15 15 15 121
Total 80 80 80 81 80 79 89 80 640

Total: 1280 birds

No. of S:P ratio

44

No. of birds

This work is part of a larger collaborative project looking at the infectious disease epidemiology, genetic and socio-economic aspects of poultry keeping in Ethiopia.

Further information can be found at www.ch4d.wordpress.com