Prevalences of Highly Pathogenic Avian Influenza (HPAI) Antibodies and H5 virus in Small-Scale Commercial and Backyard Free-Ranging Duck Enterprises in South East Asia

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ABSTRACT

Domestic ducks may play an important role in the maintenance of Highly Pathogenic Avian Influenza (HPAI) virus and transmission of the virus to chickens and humans, but specific field information is not available to support this proposition. Therefore temporal patterns of HPAI antibodies and H5 virus among farmed duck populations and in-contact chickens were examined in the Mekong Delta of Viet Nam and in Central Java of Indonesia over a period of 12 months from early 2007. In total, 96 household flocks in Indonesia and 80 in Viet Nam were monitored at bi-monthly intervals. Blood samples were collected and serum tested using the haemagglutination inhibition test to detect antibodies to circulating H5 virus in unvaccinated birds and to monitor immunity in vaccinated birds. In Indonesia, the pooled bird-level prevalence of protective antibodies (HI titre≥16) varied between samplings from 1.8 to 3.9% in unvaccinated ducks and from 0.1 to 3.1% in unvaccinated in-contact chickens. Outbreaks of clinical disease and deaths due to HPAI were frequent, causing high mortality risks in chickens. These findings show that in Indonesia, birds are highly susceptible to HPAI infection. In Viet Nam, bird-level seroprevalence ranged from 4.4 to 33.2% in unvaccinated ducks and 6.8 to 22.1% in unvaccinated in-contact chickens, while 37.6-78.5% of vaccinated ducks and 24.3-83.7% of vaccinated in-contact chickens had protective titres. No HPAI outbreaks were observed in study birds. These findings suggest that in Viet Nam, in the face of higher bird-level H5 field virus antibody prevalence compared to Indonesia and despite incomplete protection from HPAI vaccination, a substantial proportion of birds are protected from mortalities due to HPAI virus.

INTRODUCTION

Despite improved biosecurity and vaccination, outbreaks of clinical disease and deaths due to HPAI continued to occur in backyard and small-scale commercial poultry enterprises in some countries in South East Asia. Laboratory-based experimental studies and anecdotal evidence suggest that domestic ducks may play an important role in the maintenance and transmission of HPAI virus to chickens and to people but sound field information is not available to support this proposition. Therefore, a three-year Australian Centre for International Agricultural Research (ACIAR) funded project was established in 2006 to investigate the role of ducks as maintenance hosts for H5N1 infection. Several studies were conducted in duck production systems in Indonesia and Viet Nam to better understand the epidemiology of HPAI infection and to assist in developing policies for controlling the disease.

MATERIALS AND METHODS

Longitudinal observational studies were conducted in Indonesia and Viet Nam to examine the patterns of HPAI H5N1 infection in village poultry. Ducks and in-contact chickens on small-scale commercial and on backyard farms were monitored from early 2007 over a 12-month period.

In Indonesia, a total of 96 small-holder stationary duck farms were selected from sixteen villages of four districts of Central Java. In Vietnam, a total of 80 small-holder duck farms were selected from sixteen villages in eight districts of four provinces in the Mekong Delta to be enrolled in the investigation. Flocks in study farms were monitored at bi-monthly intervals. Unvaccinated sentinel ducks and in-contact chickens were blood sampled and information on changes in flock structure, husbandry practices, marketing, health status of ducks, HPAI outbreaks and flock vaccination status was collected by questionnaire. In Viet Nam, vaccinated birds were also assessed using blood samples and tracheal swabs. Serum was tested using the haemagglutination inhibition test to detect antibodies to circulating H5 virus in unvaccinated birds and to monitor immunity in vaccinated birds (HI titre≥16). Tracheal and cloacal swabs were tested for the presence of H5 viral RNA using real-time reverse transcriptase PCR.
RESULTS

Indonesia
In Indonesia, the monitored ducks were not vaccinated against HPAI. Serological data show that the bird-level seroprevalence of HPAI infection in the sampled ducks and in-contact chickens was relatively low, varying between samplings from 1.8 to 3.9% in ducks and 0.1 to 3.1% in chickens. In about 21% of flock-visits, one or more ducks were H5 antibody positive, indicating that ducks had been exposed to H5 virus and might have been carriers of the virus. H5-positive PCR results were obtained from about 2.5% of the duck flocks and 1.5% of the chicken flocks, with virus shedding more prevalent during periods when outbreaks of clinical disease due to HPAI were most common. Outbreaks were common, with nearly half of the monitored flocks experiencing at least one outbreak over the 12-month study period. Mortality risk during the outbreaks was high amongst chickens but usually much lower amongst ducks in the same farms.

Viet Nam
Unvaccinated birds in Viet Nam had higher H5 bird-level seroprevalences than the equivalent birds in Indonesia, with bird-level prevalences varying between samplings from 4.4 to 33.2% in ducks and from 6.8 to 22.1% amongst in-contact chickens. Most birds in study farms in Viet Nam were reported to be vaccinated. However, only 37.6-78.5% of reportedly vaccinated ducks and 24.3-83.7% of reportedly vaccinated in-contact chickens had protective antibody titres (HI titre≥16); 4 weeks post vaccination, only 50% of ducks or chickens had protective titres. In half of the duck and chicken flocks reported as having been vaccinated, less than 50% of birds had protective titres. Flock-level virus prevalence in Viet Nam was low with only 0.7% of duck and chicken flocks having shed H5 virus over the study period. No mortality due to HPAI was reported in any of the study villages.

DISCUSSION

Indonesia
It appears that the prevalence of protective titres is low in ducks in Indonesia, indicating that birds are highly susceptible to infection. H5 PCR products were detected in only a small proportion of birds which indicates that very few birds have virus circulating in their bodies. Contact between these and other birds can result in an HPAI outbreak with a potentially high mortality in chickens. Chickens were highly susceptible to infection, as evidenced by the higher mortality risk during outbreaks compared with ducks. High numbers of mortalities amongst chickens reduced the numbers of birds available for sampling in subsequent months, reducing precision of prevalence estimates and raising the possibility of selection bias in estimates from later samplings.

Viet Nam
Substantial proportions of reportedly vaccinated birds did not have protective antibody titres. This may have been due to inadequate immune response due to poor vaccination technique, inadequate vaccine storage or poor vaccine quality. However it may also be due to incorrect recording of vaccination status with some unvaccinated birds misclassified as vaccinated. Therefore data of this type should be interpreted with caution and efforts made to ensure that the data recorded reflect the true statuses. Incorrect recording of the vaccination status could have also affected the results from the birds reported as unvaccinated. In general, exposure of birds to HPAI virus appeared to have been more common in Viet Nam compared to Indonesia, but the prevalence of virus shedding was very low in study flocks in both countries. These results suggest that although some birds failed to produce protective antibody titres following vaccination, vaccination against HPAI can decrease the likelihood of disease outbreaks and reduce mortality in the presence of active exposure to the HPAI H5 field virus.

This ACIAR project also incorporates experimental studies. The genomes of H5N1 viruses derived from samples collected in the survey are being sequenced and challenge experiments of vaccinated and unvaccinated ducks will be performed using H5N1 viruses isolated in the field studies. These trials will determine the tissue tropism, duration of viral excretion and pathogenicity of the virus for ducks.

The results of this project will be used to develop recommendations to policy makers on HPAI surveillance and control. These are likely to include recommendations for monitoring infection in ducks and for the use of participatory approaches for reporting outbreaks to provide information on the behaviour of the HPAI virus in the field. Improved control activities due to enhanced surveillance should assist in reducing the risk of virus transmission to other poultry species and to humans.