Infection and Transmission Dynamics of Highly Pathogenic Avian Influenza H5N1 in Chickens and Pekin ducks Infected Experimentally

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INTRODUCTION

The current panzootic with highly pathogenic avian influenza (HPAI) H5N1 virus has displayed marked alterations in its ability to cause disease in previously "resistant" wild bird hosts and thus has highlighted the complexity of host-virus interactions during AI infection. To establish whether similar parameters of infection and shedding are seen with contemporary 'Eurasian lineage' H5N1 viruses, representing the westward movement of these viruses from their origins in South East Asia into Europe, compared to more conventional HPAI H5N1 viruses, a host range study was performed using chickens and Pekin ducks.

MATERIALS AND METHODS

- Three challenge groups of ten 3-week-old chickens and Pekin ducks were each infected intraocularly with 10^6, 10^4 or 10^2 EID_{50} with either a 'conventional' HPAI H5N1 virus, A/turkey/England/50-92/1991 (tyEng91) or an 'Eurasian-lineage' virus, A/turkey/Turkey/1/2005 (tyTR05) H5N1 HPAI.
- Infected birds were immediately placed in contact with five uninfected, age- and species-matched in-contact birds.
- Cloacal and oropharyngeal swabs were taken 8-hourly for chickens and daily for Pekin ducks, and the presence of virus was determined by matrix gene real-time RT-PCR [2, 3].
- Temporal, population and bird-level analyses of viral load [measured as relative equivalent units (REU)[1] of viral RNA], transmission and mortality were performed.

RESULTS

Marked differences, relating to species, were observed for mortality, infection rates and shedding profiles (Table 1). Viral shedding was more prevalent and levels were predominantly higher from the buccal route for both viruses in both bird species. Substantially higher levels of shedding were observed from infected rather than in-contact chickens for both viruses (Table 2), while similar levels were observed in both infected and in-contact ducks infected with tyTR05.

A/turkey/Turkey/1/2005

Infections with tyTR05 produced greater mortality, was more infectious and transmissible, at lower doses, in ducks than chickens (Fig 1a, c).

- 100% mortality in the 10^6 and 10^4 infected and in-contact duck groups (4-6 dpi), with 50 and 60% mortality in the 10^2 infected (5-10dpi) and in-contact (8-11dpi) ducks respectively.
- 100% mortality in both 10^6 and 10^4 tyTR05 infected chicken groups (36-52 hpi), and all in-contact birds (44-92hpi). Only a 10% loss was seen in the 10^2 infected chicken groups (44hpi) with no evidence of transmission to in-contact birds.

Successful infection of chickens with tyTR05 resulted in 100% mortality, while 100% infection was obtained for all ducks (for all doses), 50-40% of 10^2 infected ducks survived and continued shedding virus.

A/turkey/England/50-92/1991

Infections with tyEng91 resulted in greater mortality, infection and transmission in chickens at lower doses, while failing to infect ducks at any dose. Transmission and mortality rates in chickens were reduced with tyEng91 infection compared to tyTR05 (Fig 1a, b).

- 100% mortality was seen in 10^6 tyEng91 infected (22-100 hpi) and in-contact chicken groups (6-8dpi), with 70% mortality in 10^4 infected birds (36-52 hpi) and no in-contacts were lost.
- No evidence of infection or clinical signs were evident in those birds that survived.

Table 1: Mortality and transmission of HPAI H5N1

		A/turkey/Turkey/1/2005		
		Infected	Contact	
	Dose (EID_{50})	Mortality	Mortality	Transmission
Chicken	10^6	100%	100%	100%
	10^4	100%	100%	100%
	10^2	10%	0%	0%
Pekin duck	10^6	100%	100%	100%
	10^4	100%	100%	100%
	10^2	50%*	60%*	100%

* 100% infection obtained

		A/turkey/England/50-92/1991		
		Infected	Contact	
	Dose (EID_{50})	Mortality	Mortality	Transmission
Chicken	10^6	100%	100%	100%
	10^4	70%**	0%	0%
	10^2	0%	0%	0%
Pekin duck	10^6	0%	0%	0%
	10^4	0%	0%	0%
	10^2	0%	0%	0%

**70% infection obtained

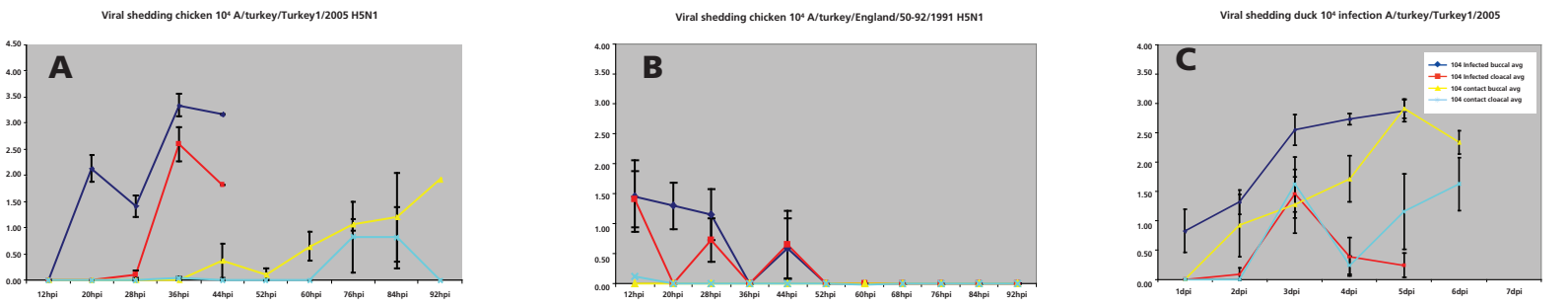
Table 2: Mean population viral shedding * (log REU RNA)**

		A/turkey/Turkey/1/2005			
	Dose (EID_{50})	Buccal-Infected	Clocal-Infected	Buccal-Contact	Cloacal-Contact
Chicken	10^6	2.41	1.34	0.89	0.44
	10^4	2.32	1.38	0.63	0.68
	10^2	0.21	0.29	0	0
Pekin duck	10^6	1.90	0.20	1.56	0.27
	10^4	1.87	0.47	1.52	0.77
	10^2	0.63	0.10	0.72	0.08

		A/turkey/England/50-92/1991			
	Dose (EID_{50})	Buccal-Infected	Clocal-Infected	Buccal-Contact	Cloacal-Contact
Chicken	10^6	2.31	1.58	0.52	0.31
	10^4	0.37	0.16	0	0
	10^2	0	0	0	0
Pekin duck	10^6	0	0	0	0
	10^4	0	0	0	0
	10^2	0	0	0	0

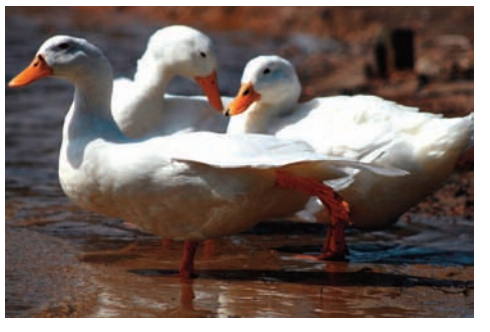
*** mean of all samples during period of detectable shedding

FIG 1: Mean population viral shedding at 10^4 infectious dose (SE bars shown)



CONCLUSIONS

- While infection and mortality rates observed in chickens with both viruses were high, A/turkey/Turkey/1/2005 was more infectious, virulent and transmissible at lower doses.
- Infection and mortality observed in ducks were found to be even greater than in chickens when infected with A/turkey/Turkey/1/2005, and negligible when infected with A/turkey/England/50-92/1991.
- This suggests a substantial shift in virulence for Eurasian lineage HPAI H5N1 for ducks, which are resistant to a more conventional HPAI H5N1 virus.
- Viral shedding in the absence of clinical signs and mortality in ducks further highlights these birds as vectors for AI virus.



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Acknowledgements

This work was funded by the Biotechnology and Biological Sciences Research Council (BBSRC) FT5094. Attendance at this meeting was supported by the European Union 6th Framework project FLU-LAB-NET.