CROSS-PROTECTION CONFERRED BY THE VACCINE STRAIN *EIMERIA MAXIMA* 013 AGAINST SIX HETEROLOGOUS PATHOGEN STRAINS

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INTRODUCTION

The study was designed to assess the immunogenicity of the vaccine strain *E. maxima* 013 when administered in 1-day-old chicks (minimum recommended age for vaccination) against six heterologous pathogen strains from six very different geographic locations.

MATERIALS AND METHODS

The experiment's design takes into account the article by A. G. Martin, H. D. Danforth, J. R. Barta and M. A. Fernando "Analysis of Immunological Cross-protection and Sensitivities to Anticoccidial Drugs among Five Geographical and Temporal Strains of *Eimeria maxima*", International Journal of Parasitology, Vol. 27, No. 5, p.527-533, 1997. The 1-day-old chicks were immunised with 230 oocysts of *E. maxima* 013 on Day 0. Exposure tests were performed separately for each strain 14 days post-vaccination, in both immunised groups and non-immunised control groups (Table 1). All animals were housed in floor-pens under the same environmental conditions. Oocyst counts in fresh faeces were assessed daily for the first eight days with the aim of monitoring the vaccination (immunisation) process through the oocyst elimination profile, as well as for seven days following the exposure test to compare oocyst elimination between the exposed vaccinated and control groups. Intestinal lesions were assessed at seven days after exposure, which is the optimum time to observe post-exposure *E. maxima* lesions. This study was performed with two unvaccinated control groups: one group was exposed on the same day as the vaccinated chicks and the other group was not exposed. The results obtained in the unvaccinated exposed groups were compared with the vaccinated exposed groups with the aim of studying the degree of cross-protection.

Table 1. Summary of study groups.

Groups		Exposure at 15 days
A (Vaccinated)	A1	*E. maxima* 019 (Tyson)
	A2	*E. maxima* 020 (41)
	A3	*E. maxima* 021 (Zaragoza)
	A4	*E. maxima* 022 (Girona)
	A5	*E. maxima* 016 (Houghton)
	A6	*E. maxima* 023 (Philippines)
B (Unvaccinated)	B1	*E. maxima* 019 (Tyson)
	B2	*E. maxima* 020 (41)
	B3	*E. maxima* 021 (Zaragoza)
	B4	*E. maxima* 022 (Girona)
	B5	*E. maxima* 016 (Houghton)
	B6	*E. maxima* 023 (Philippines)
	B7	Not exposed

RESULTS AND DISCUSSION

In all the exposure tests performed, the birds in the A subgroups (A1 to A6) eliminated a much reduced number of oocysts post-exposure, while a high number of oocysts were eliminated by the B subgroups (B1 to B6). This difference in oocyst elimination in the vaccinated groups clearly indicates a good degree of protection conferred by the vaccine strain *E. maxima* 013 (only in inoculated animals in the A subgroups). Moreover, the number of oocysts eliminated on Days 6 and 7 after exposure in animals from the A subgroups was very similar across subgroups (less than 700 oocysts/g). This clearly indicates that there is no difference in terms of cross-protection between the various strains used in the exposure tests. For this reason, no relationship was observed between the degree of cross-protection and geographic distance with respect to *E. maxima* 013 (parental strain isolated in Spain by Dr Emilio del Cacho). The animals in the B7 group (inoculated with PBS and not exposed) eliminated no oocysts during the study, confirming that no cross-contamination between study groups took place in the study facilities. For the other parameters assessed, clear differences were recorded between the vaccinated (A1 to A6) and control (B1 to B6) subgroups for lesions in the mid-intestine, assessed 7 days after exposure to 6 different strains of *E. maxima*. No animal in the unvaccinated and not exposed subgroup (B7) presented lesions in the mid-intestine. Statistically significant differences were detected in the vaccinated subgroups (A1 to A6) in comparison with the exposed control groups (B1 to B6) at necropsy. Among those animals in the vaccinated subgroups who presented lesions, none were above grade 1 (based on the scale by Johnson and Reid, 1970). However, in the unvaccinated exposed subgroups, the majority of lesions were classified as grade 2 or higher. Furthermore, grade 4 lesions were observed in subgroups B3, B5 and B6 (Table 2). This indicates that the aggressiveness of the strains is variable, but the degree of cross-protection conferred by *E. maxima* 013 does not change, even when faced with exposure to a very aggressive strain.

Table 2. Lesions in the mid-intestine.

Subgroup/Exposure		Mean score	P value
A1 (vaccinated + exposed)	*E. maxima* 019 (Tyson)	0.2	< 0.05
B1 (unvaccinated + exposed)		2.5	
A2 (vaccinated + exposed)	*E. maxima* 020 (41)	0.2	< 0.05
B2 (unvaccinated + exposed)		2.3	
A3 (vaccinated + exposed)	*E. maxima* 021 (Zaragoza)	0	< 0.05
B3 (unvaccinated + exposed)		3.0	
A4 (vaccinated + exposed)	*E. maxima* 022 (Girona)	0.5	< 0.05
B4 (unvaccinated + exposed)		2.2	
A5 (vaccinated + exposed)	*E. maxima* 016 (Houghton)	0.2	< 0.05
B5 (unvaccinated + exposed)		3.4	
A6 (vaccinated + exposed)	*E. maxima* 023 (Philippines)	0.3	< 0.05
B6 (unvaccinated + exposed)		3.6	

The results obtained clearly indicate the high degree of protection conferred by the vaccine strain *E. maxima* 013 against exposure to 6 strains of *E. maxima* pathogens from different geographic locations.

In conclusion, the results obtained with regard to protection (reduced oocyst excretion in faeces and reduced macroscopic lesions in the mid-intestine) demonstrate the suitability of the vaccine strain *E. maxima* 013 for protection against very different field strains.

REFERENCES

- Martin, A. G., Danforth, H. D., Barta, J. R. and Fernando, M. A. (1997) Analysis of Immunological Cross-protection and Sensitivities to Anticoccidial Drugs among Five Geographical and Temporal Strains of E. maxima. International Journal for Parasitology 27 (5): 527-533.
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