Development of an oral PCV2 vaccine

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Background

- Porcine Circovirus 2 (PCV2) is endemic in most pig producing countries, and is the cause of PCV Associated Disease (PCVAD)
- Injectable vaccines are widely used as part of a control policy
- Oral vaccination presents benefits of reduced labour and reduction of individual pig handling, increasing welfare
- This *in vivo* experiment was designed to assess efficacy of a novel vaccine delivery system using a freeze dried recombinant *Saccharomyces cerevisiae* yeast expressing the PCV2b capsid protein.

Aim and Methods

- To quantify viral load in multiple tissues and compare levels in vaccinated and unvaccinated pigs after PCV2 challenge
- Histopathological examination and immunohistochemistry (IHC) to detect PCV2 capsid protein
- Modify an established scoring system to develop and compare histological and IHC scores between pigs (Table 1).
- Combine histological and IHC scores to produce an overall tissue score.
- qPCR to quantify viral DNA copy numbers in serum and a range of tissues
- Cytometric bead assay to measure serum inflammatory cytokine concentrations throughout the study.

Table 1 Summary of histological and IHC scoring system.

Scoring system	Features	Score
Lymphoid depletion	Normal	0
	Mild depletion	1
	Moderate depletion	2
	Severe depletion	3
Inflammation	Normal	0
	Mild histiocytic inflammation	1
	Moderate histiocytic inflammation	2
	Severe histiocytic inflammation	3
Immunohistochemistry	Negative	0
	Less than 10% follicles staining	1
	10-50% follicles staining	2
	>50% follicles staining	3

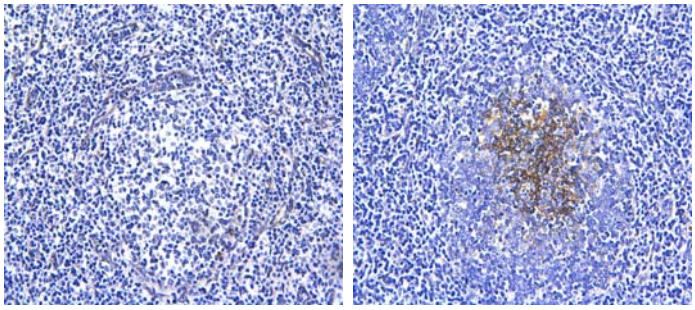

Figure 1. Mesenteric lymph node : IHC using anti-PCV2 antibody (right) and anti mouse isotype negative control (left). Brown staining shows cytoplasmic labelling and virus expression in macrophages.

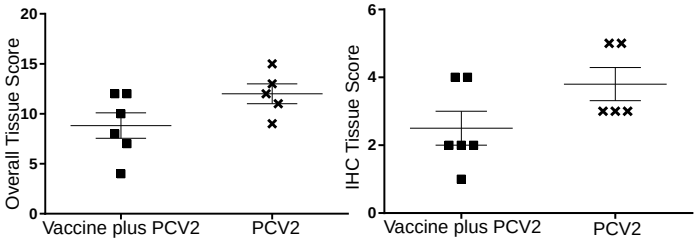

Figure 2. Box plots showing an increase in tissue score (left) and IHC score (right) in unvaccinated pigs compared to vaccinated pigs

Results

- Higher total tissue score and IHC scores in unvaccinated compared to vaccinated group (Fig 2)
- Viral DNA copy levels higher in lymphoid tissue in unvaccinated group compared to vaccinated group
- Peak viraemia reduced in vaccinated compared to unvaccinated group
- No rise in pro-inflammatory cytokine concentration in vaccinated compared to a rise in the unvaccinated group.
- Increase in faecal IgA titre in vaccinated compared to unvaccinated group.

Conclusions and Relevance

- Proof of concept for a recombinant yeast based vaccine
- Freeze dried recombinant yeast is not considered a Genetically Modified Organism which has economic benefits to its production and it has “Generally Regarded as Safe” status
- Reduced labour and welfare benefits from oral vaccine delivery
- Freeze dried delivery system removes the need for a cold chain.

References

Patterson, R., et al., *Oral application of freeze-dried yeast particles expressing the PCV2b Cap protein on their surface induce protection to subsequent PCV2b challenge in vivo.* Vaccine, 2015

Opriessnig, T., et al., *Experimental reproduction of postweaning multisystemic wasting syndrome in pigs by dual infection with Mycoplasma hyopneumoniae and porcine circovirus type 2.* Vet Pathol, 2004. **41**(6): p. 624-40