Title	**Antibody binding to antigenic targets in the rumen**
Project Timeframe	Nov 2017 – Sep 2020
Countries Involved	New Zealand (AgResearch) Australia (University of Technology, Sydney) Argentina (National University of Centre of Buenos Aires; National Agricultural Technology Institute)
Aims	The overall goal was to increase our understanding of protein antigen selection for an anti-methanogen vaccine, to improve the effectiveness of antibody interactions with methanogen cells. Specific aims were to: • Compare different expression systems to determine the best host for producing recombinant proteins for an effective vaccine. • Develop methods to study the strength (avidity) of antibody interaction with methanogen proteins. • Identify and characterise immunological epitopes on methanogen proteins to optimise antigen design. • Develop immunomagnetic capture technology (ICT) as a tool to increase our understanding of antibody binding to methanogens in the rumen.
Research Highlights	• Developed ICT to understand binding of antibodies to the surface of methanogens in the rumen. • Developed methods to determine avidity of antibody binding to antigenic targets. The ICT and avidity methods are now currently being used in the PGgRc-NZAGRC methane vaccine programme, which has the goal of producing a vaccine as a mitigation strategy to reduce methane emissions in farmed ruminants in New Zealand and worldwide. • Produced new knowledge and understanding of which parts of a protein antigen are recognised by the immune system. This will help optimise antigen and improve the effectiveness of an anti-methanogen vaccine and potentially other type of vaccines. • Established international collaborations with researchers in Argentina and Australia.
Future Work	• Further work to demonstrate the utility of the antigen targeting methods developed, and generate guidelines for antigen design, especially from complex proteins that are difficult to work with in their entirety. • Investigate the role of glycosylation of methanogen proteins in producing effective vaccine antigens.

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Key Research Output(s)	Journal article(s)
	Khanum, S., Roberts, J., Heathcott, R.W., Bagley, S., Heiser, A., Janssen, P.H., Wedlock, D.N. (In Prep.) Cross-reactivity of antibodies to different rumen methanogens demonstrated using immunomagnetic capture technology. *Frontiers in Microbiology*.
	Khanum, S., Miller, P., Heiser, A., Wedlock, D.N. Janssen, P.H. (In Prep.) An improved method to calculate the avidity index (A1) of serum antibodies using Bayesian statistical models. *Journal of Immunological Methods.*
	Khanum, S., Carbone, V., Gupta, S., Yeung, J., Shu, D., Wilson,T., Parlane, N., Altermann, E., Estein, S., Heiser, A., Janssen, P.H., Wedlock, D.N. (In Prep.) Mapping immunogenic epitopes of an adhesin-like protein from *Methanobrevibacter ruminantium* M1: comparison of empirical with *in silico* prediction methods. *Scientific Reports*.
	Conference presentations
	Khanum, S., Yeung, J., Shu, D., Gupta, S., Wilson, T., Parlane, N., Altermann, E., Heiser, A., Janssen, P.H., Wedlock, D.N. Characterisation of immunogenic epitopes on a methanogen surface protein. *NZMS annual conference,* Palmerston North. 25-28 November 2019.
	Khanum, S., Yeung, J., Shu, D., Gupta, S., Wilson, T., Parlane, N., Altermann, E., Heiser, A., Janssen, P.H., Wedlock, D.N. Comparing *in vivo* and *in silico* techniques to map the immunogenic B and T-cell epitopes of a *Methanobrevivbacter ruminantium* M1 adhesin protein. *QMB meeting,* Queenstown. 2-4 September 2019.
	Khanum, S., Shu, D., Yeung, J., Roberts, J., Heathcott, R.W., Heiser, A., Janssen, P.H., Wedlock, D.N. Development of immunomagnetic capture technology to isolate methanogens from rumen samples. *Microbes and Molecules conference,* Dunedin. 26-29 November 2018.