Vaccine for methane reduction in ruminants

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NEW ZEALAND AGRICULTURAL GREENHOUSE GAS Research Centre

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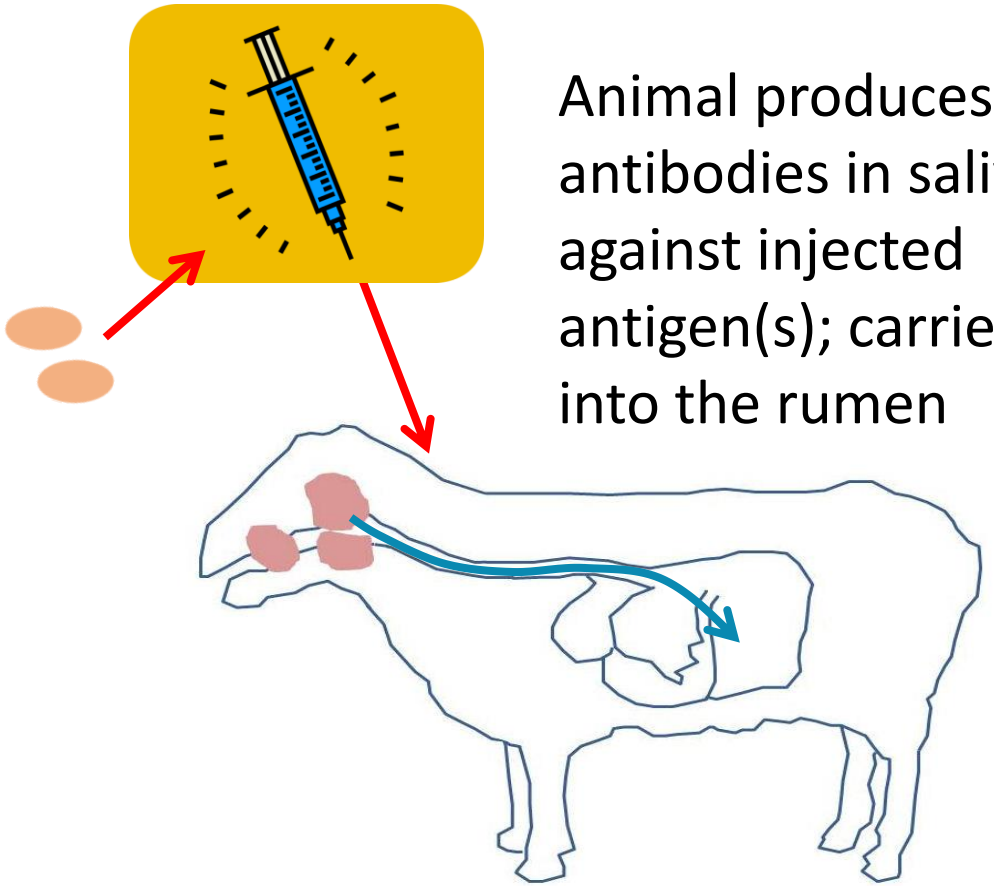
WORKING TOGETHER

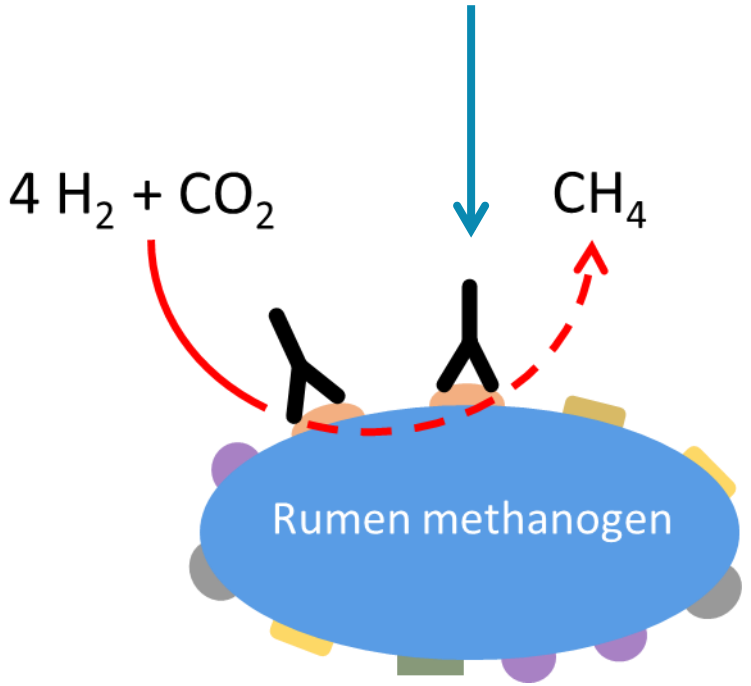
How will it work?

Vaccine consists of Antigen(s) + Adjuvant/vaccination protocol



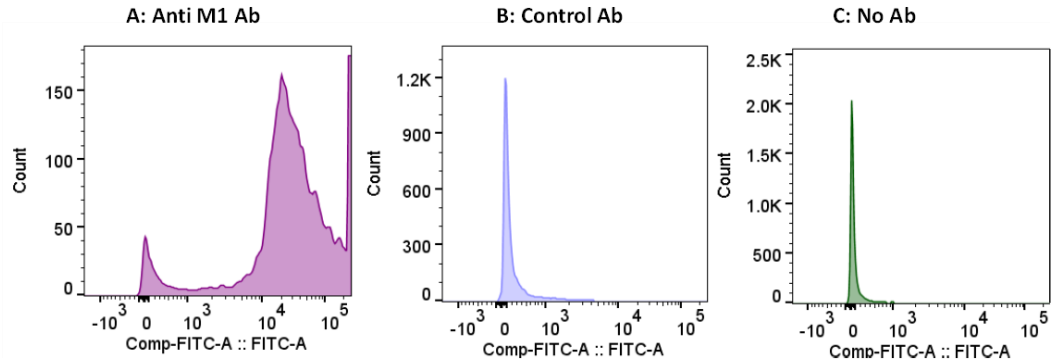
Animal produces antibodies in saliva against injected antigen(s); carried into the rumen

Antibodies bind to corresponding antigens on surface of methanogens



Can it work?

- Anti-acidosis vaccines targeting rumen microbes are effective
- Vaccines targeting urease enzymes in the rumen reduce urease activity
- Engagement with Methane Vaccine Think Tank (MVTT)
- Sufficient antibodies are produced in saliva
- Antibodies bind to methanogens in rumen fluid
- We have cultured isolates and genome sequences of target methanogens
- There are antigens in common across multiple methanogen species



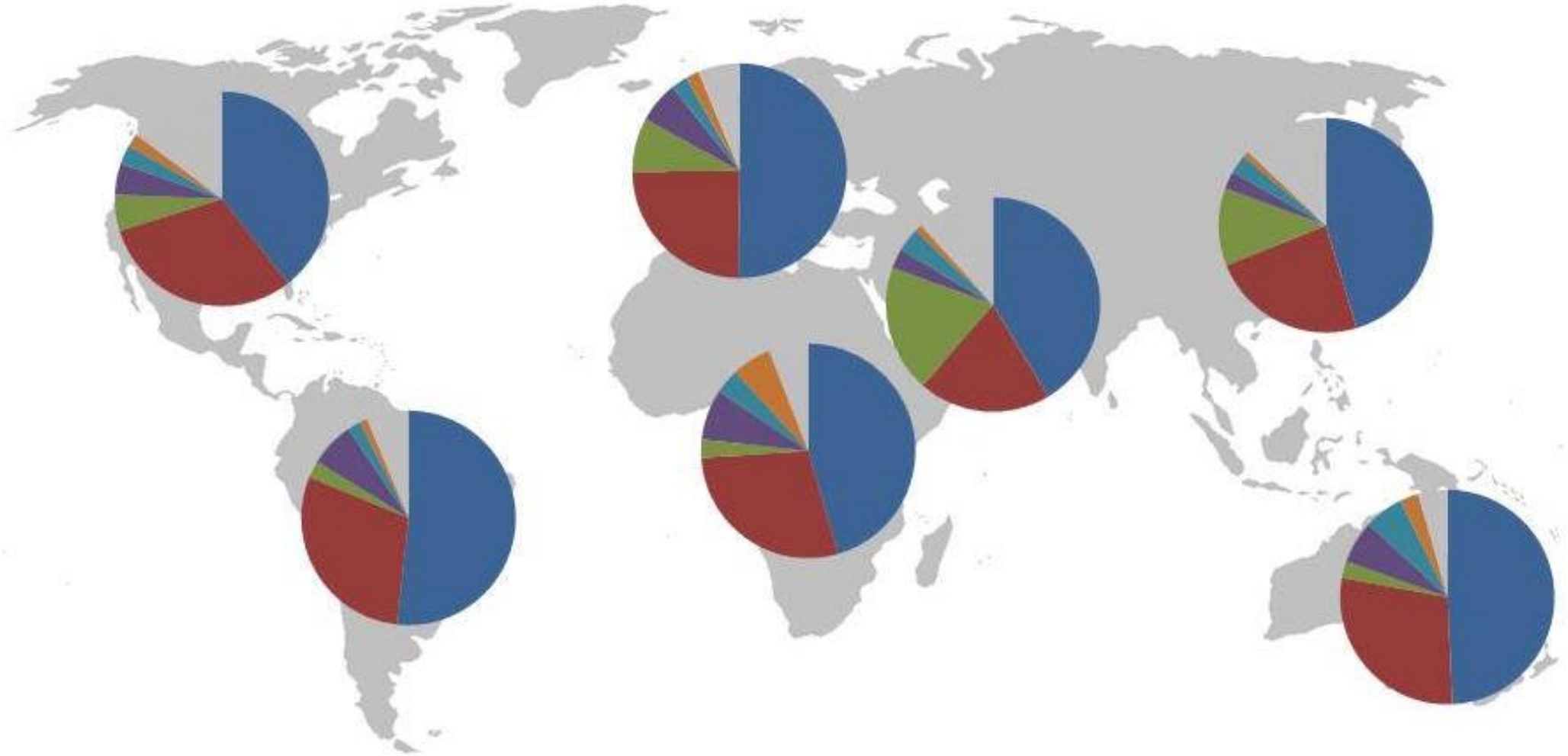
Shu *et al.*, poster at this conference

What impact will it have?

- Aiming for 30% methane reduction, but has potential for more

- Low frequency intervention
- Doesn’t require a change to farm systems
- Applicable to pastoral farming enterprises like ours in NZ
- Applicable to all farmed ruminants (cattle, sheep, deer, goats, etc.)
- Vaccination is an accepted farm practice
- No residues in saleable products
- Auditability

An anti-methanogen vaccine has global application

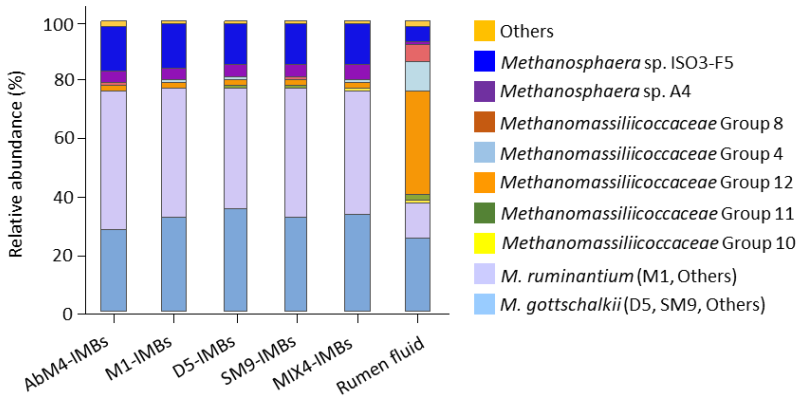


Henderson *et al*., 2015

What is the latest progress?

Vaccine consists of Antigen(s) + Adjuvant/vaccination protocol

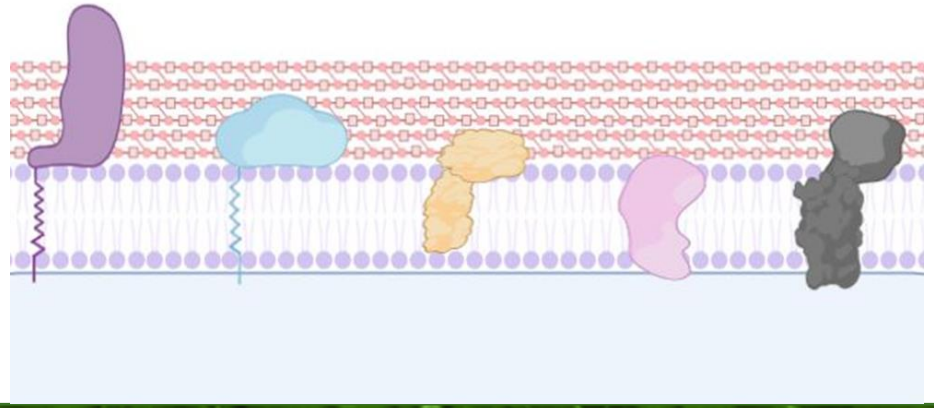
- We now have a set of 7 defined antigens that result in antibodies that bind to methanogens cells → break the antigen + adjuvant dilemma
- Antibodies have various biological impacts on growing methanogens
- Antibodies bind to native rumen methanogens in rumen fluid
- We can increase the binding strength (avidity) between antibodies and their targets (antigens) → current trial to see what impact this has, and understand the results



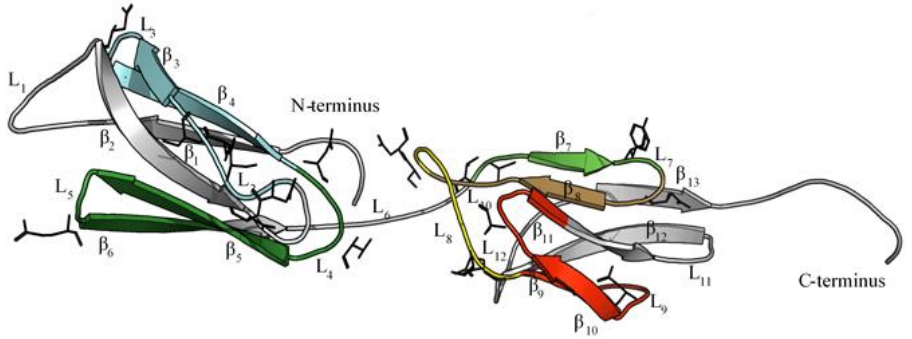
Khanum *et al.*, to be submitted for publication

What are we doing now and next?

- Addressing barriers to producing an effective vaccine → overcome these
- Identifying antigens for vaccine → antigens for methane impacts
- Determine epitopes within antigens → focused immunity
- Production of antigens → better mimics of methanogen antigens
- Better understanding of antibody binding to targets → increased avidity
- Animal trials to test our advances in knowledge → methane reductions?



Yeung *et al.*, in preparation



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How long will it take?

- A vaccine will contribute significantly to any reduction targets because of its utility, e.g., to a target of reducing methane to 24-47% below 2017 levels by 2050

- Focusing on understanding and overcoming the potential barriers to an effective vaccine has accelerated progress
- We can also increase progress by bringing in additional expertise as new challenges and opportunities are identified
- Once a working vaccine is available, it will take 3 – 5 years to get that onto farm (registration, production impacts, manufacturing)

Who is doing this research?

- AgResearch (Hopkirk Research Institute, Grassland Research Centre)
- Victoria University of Wellington (Mattie Timmer, Bridget Stocker)
- Moredun Research Institute (Tom McNeilly)
- University of Technology Sydney (Iain Duggin)
- Instituto Nacional de Tecnología Agropecuaria, Argentina (Silvio Cravero)
- Universidad Nacional del Centro de la Provincia de Buenos Aires (Silvia Estein)
- Advised by the Methane Vaccine Think Tank

- Funded by
  - The Pastoral Greenhouse Gas Research Consortium (PGgRc; NZ's pastoral farmers and their organisations, and MBIE)
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