RMG NETWORK
RUMEN MICROBIAL GENOMICS NETWORK

Newsletter February 2024

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Flagship Projects

Greener Cattle Initiative

Hydrogen production and hydrogen utilization in the rumen of beef and dairy cattle: key rumen microbiome measurements to understand mechanisms controlling methanogenesis and mitigating enteric methane emissions

(Contribution by R. Mackie)

Six international research hubs centered at prestigious industry and academic institutions across the globe will participate in the project :

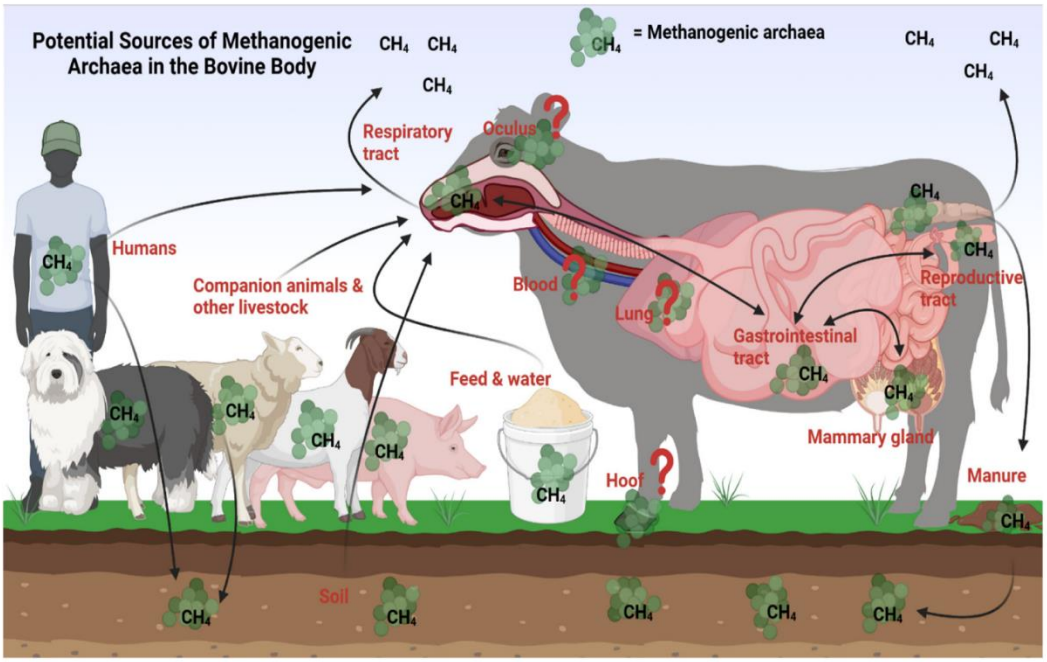
- Research Hub 1: Rod Mackie & Josh McCann, University of Illinois at Urbana-Champaign, USA Lead institution
- Research Hub 2: Graeme Attwood, Peter Janssen & Bill Kelly, Grasslands Research Institute, AgResearch, New Zealand
- Research Hub 3: Leluo Guan, Tim McAllister and Stephanie Terry, University of Alberta and Agriculture and Agri-Food Canada Lethbridge Research Center
- Research Hub 4: Phillip Pope and Sharon Huws, Norwegian University of Life Sciences, As and Queens University, Belfast
- Research Hub 5: Itzhak Mizrahi, Ben Gurion University, Israel
- Research Hub 6: ProAgni Australia; Diane Ouwerkerk (Dept of Agriculture and Fisheries, Queensland), Athol Klieve (University of Queensland) and Matthias Hess (University of California-Davis)

The innovative systems approach of this project will reveal hidden mechanistic details missing from recent microbiome studies examining ***CH_4 reduction***. This approach using coupled measurements of fluxes and turnover of key metabolites coupled with identification of microbes that are actively involved in these biochemical reactions and processes is fundamental to understanding how CH_4 mitigation impacts these processes in the rumen. The use of advanced bioinformatic and systems approaches, we will be able to identify key regulatory mechanisms that can be used for microbiome manipulation that promote the low methane emitting phenotype so that sustainable decreases in CH_4 emissions can have the performance and health co-benefits for the performance and health of beef and dairy cattle industries. The delivery of research outcomes will be through multiple media platforms that include high impact journal papers, presentations at scientific meetings, national society meetings and specialized webinars and other social media delivery networks.
Click here to learn more: Broadening the approach to livestock methane mitigation

Relevant publications & Community groups

"Holistic View and Novel Perspective on Ruminal and Extra-Gastrointestinal Methanogens in Cattle"

published by Godson Aryee (first author) and Samat Amat (Corresponding author) in Microorganisms, 2023 Nov 10;11(11):2746. doi: 10.3390/microorganisms11112746.



Abstract

In this review article, we provided a comprehensive survey of the methanogenic archaea present in the rumen and extra-gastrointestinal organs of cattle such as the reproductive and respiratory tracts and highlighted the potential interactions between the ruminal and extra-intestinal methanogens. Our recent sequencing-based studies revealed that methanogenic archaeal species (e.g. Methanobrevibacter spp.) present in vagina (pregnant and non-pregnant beef cattle, uterus, as well as bull semen samples, suggesting that methanogenic archaea might be a part of commensal members of the female and male reproductive microbiota in cattle. We also observed *Methanobrevibacter* spp. in the upper respiratory tract of beef cattle and identified that certain methanogenic taxa are shared by the ruminal, respiratory, and reproductive tracts of cattle as potential core taxa. Thus, these observations coupled with the identification of methanogenic archaea in the calf fetal intestines that we and others investigated, as well as the increasing appreciation of the microbiome-gut-organ axis together prompted us to discuss the potential interactions between ruminal and extra-gastrointestinal methanogenic communities in the present article. We also discussed every possible seeding source of ruminal methanogens both within a cattle body and external environments (Figure). We believe that a traditional singular focus on ruminal methanogens may not be sufficient, and a holistic approach which takes into consideration of the transfer of methanogens between ruminal, extra-gastrointestinal, and environmental microbial communities is of necessity to develop more efficient and long-term ruminal CH_4 mitigation strategies. Taxonomic, genomic, and metabolic characteristics of the methanogenic archaeal species in the rumen and other bovine body sites should be investigated to gain more holistic insights into the methanogens in cattle.

The team

Dr. Samat Amat is an Assistant Professor in Livestock Microbial Ecology at the Department of Microbiological Sciences, North Dakota State University (NDSU), Fargo, United States. Dr. Amat joined NDSU after his Postdoctoral training in Animal Microbiome at the University of Alberta, Edmonton, Canada. He completed his PhD degree in Microbiology through the University of Calgary, and Agriculture Agri-Food Canada, Lethbridge Research and Developmental Center, Alberta, Canada in 2019.

Dr. Amat's current research program at NDSU focuses on harnessing livestock microbiomes for improved animal health and production. His areas of research are multidisciplinary and include characterizing the role of the maternal bovine microbiome in developmental programming, developing reproductive microbiome-targeted strategies to improve cattle fertility, and using antibiotic alternatives

to mitigate bacterial pathogens associated with bovine respiratory disease and liver abscesses. Dr. Amat's program uses basic microbiology and advanced molecular biology/bioinformatics.
Dr. Amat's full list of publications can be found in the ResearchGate:
(https://www.researchgate.net/profile/Samat-Amat/research)

Godson Aryee is a PhD student in Department of Microbiological Sciences, North Dakota State University, Fargo, ND, USA. Under Dr. Samat Amat's supervision, Mr. Aryee is currently conducting a USDA-AFRI funded project to investigate the impact of altering maternal microbiota via high forage and high grain diets during gestation on offspring microbiome development and methane emissions in beef cattle.

Multi-omics analyses reveal rumen microbes and secondary metabolites that are unique to livestock species

Abstract

In this work we compared ruminant livestock that varies in resilience, diet, and diseases prevalence. We found that these animals cooperate with diverse microbes that provides different useful biological traits, such as feed conversion, greenhouse gases emission and secondary metabolites, which are effector in livestock vectors-pathogens interaction. Our results demonstrate that rumen fermentation at the interface of host genetics, microbes, and diets has a significant implication in the production of complex secondary metabolites, that play critical roles in livestock rumen metabolism and confer unique ecological traits to the host organisms. Such knowledge is a gateway to manipulate rumen ecosystem to make livestock husbandry sustainable and resilient for climate adaptation.

The team

The International Centre of Insect Physiology and Ecology (*icipe*) **http://www.icipe.org** was established in Kenya in 1970. *icipe icipe*'s Mission "The Centre's vision is to pioneer global science in entomology, to improve the well being and resilience of people and the environment to the challenges of a changing world, through innovative and applied research, alongside deep exploratory study, impact assessment, evaluation and sustainable capacity building. In the process help alleviate poverty, ensure food security and improve the overall health status of peoples of the tropics by developing and extending management tools and strategies for harmful and useful arthropods, while preserving the natural resource base through research and capacity building".

Dr Merid N Getahun (Chemical ecologist) is a senior Research scientist at the International Centre of Insect physiology and Ecology. My research area focuses on livestock host-vectors-pathogens/rumen microbes interaction: Secondary metabolites change due to trypanosomes or other relevant pathogens infection in domestic animals, and how those odors can be exploited for development of livestock diseases transmission blocking, development of simple diagnostic tool, naturally inspired therapeutics biomolecules, attractants and repellents for management of vectors of livestock disease. In Addition, I am working on rumen microbes and metabolites manipulation to make ruminant livestock environmentally sustainable, and resilient in time of climate change challenges.

Victor Omondi (MSc) in analytical Chemistry, from University of Nairobi, Department of Chemistry. His research interests are focused on the application of bioanalytical techniques such as metabolomics to understanding systems biology, including host-microbe interactions. And how such interactions can be used to solving various global challenges.

Conferences - symposia - seminars – webinars

Congress on Gastrointestinal Function: April 2024 Urbana-Champaign, USA

The CGIF maintains a tradition established in 1951 to provide academic and industry scientists a biennial forum to present the latest advances in our understanding of gastrointestinal microbiology, (immuno)physiology, and nutritional sciences.

The topics presented at the congress include studies with livestock and poultry species for food production and biomedical research, as well as clinical and nutritional studies relevant to improving human health and well-being. Research that addresses the environmental and public health impacts from gastrointestinal microbiology (e.g., the ecology of antibiotic resistance, food safety, and waste management) is also welcome.

The invited talks will cover the microbiota of the human and animal gut, and the state-of-the-art technology on display will span all areas of gut microbiome research.

Ed Bayer (Marvin P. Bryant Memorial Speaker, Weizmann Institute, Israel). *Cellulosome-Producing Bacteria from the Environment to the Rumen and Human-Gut Microbiomes*.

Rekha Seshadri (DoE-JGI, USA). *A Census of Genomes from the Rumen Microbiome: Charting New Frontiers Beyond Hungate1000*

Manuel Kleiner (North Carolina State University, USA). *Dietary Protein Source Strongly Impacts Gut Microbiota Composition and Function.*

Ami Bhatt (Stanford University, USA). *From Precise Microbial Genomics to Precision Medicine.*

Lindsay Hall (Birmingham University, UK). *The Ying and Yang of Microbiome Signatures in Early Life.*

Mads Albertsen (Alborg University, Denmark). *From Chromosomes to Cells Using Third-Generation Sequencing.*

Gene Tyson (Queensland University of Technology, Australia). *New Tools and Technologies to Unlock the Therapeutic Potential of the Human Microbiome.*
Alex Kostic (Harvard Medical School, USA). *The Human Gut Microbiome: Lessons from our Ancestors.*

This is a reminder that abstracts and registrations are now being accepted for the 2024 Congress on Gastrointestinal Function. The 2024 Congress will take place April 8 to 10, 2024, at the Beckman Institute for Advanced Science and Technology at the University of Illinois, Urbana-Champaign. The deadline to submit an abstract is 11:59 PM CST on Friday, March 8, 2024.
Save $50 on your registration fee if you register no later than March 11, 2024. The discounted rate is $200 for students and postdoctoral fellows or $300 for scientists, industry, and other registrants.
The conference has secured a block of rooms at the Hampton Inn Champaign/Urbana. Our Congress block rate is $119.00 per night plus taxes, and reservations must be made by Saturday, March 9, 2024. Additional hotel details can be found online.

International Anaerobic Fungi Congress

The second International Anaerobic Fungi Congress will take place online from **October 15th to 17th, 2024**. This conference represents the second installment of the successful IAFC, which was first held in 2022 with around 100 participants. It is the first and only scientific congress worldwide that is specifically directed at the phylum Neocallimastigomycota, a special group of strictly anaerobic fungi that bear great potential for anaerobic biogas production from lignocellulosic (waste) products. The IAFC2024 is organized by the international Anaerobic Fungi Network (AFN), a non-profit, collaborative group of researchers from all over the world interested in Neocallimastigomycota. The AFN currently has around 160 members.

75th EAAP Annual Meeting

1/5 September 2024 - Florence, Italy. The general topic of this Congress will be “Global quality: environment, animals, food“.
Different sessions will be organized and jointly organized between the eleven EAAP Study Commissions to cover various areas of knowledge related to animal science, such as genetics, nutrition, physiology, animal health and welfare, precision livestock farming, horses, pigs, insects, livestock farming, cattle, sheep and goat.
Abstract deadline: 1st March

Jobs

Researcher : Ruminants
https://groupeavril.csod.com/ux/ats/careersite/2/home/requisition/3844?c=groupeavril&lang=en-US

PhD project : Model-based design of optimal synergetic strategies for methane mitigation with fermentation co-benefits for ruminants

We are looking candidates to participate to the international doctoral Cotutelle programme (ADI) funding call of Université Paris-Saclay (France) with a PhD project between INRAE (France) and CSIC (Spain)

The PhD project is entitled: **Model-based design of optimal synergetic strategies for methane mitigation with fermentation co-benefits for ruminants**. The PhD supervisors are Rafael Muñoz-Tamayo (INRAE), David Yáñez-Ruiz (CSIC) and Milka Popova (INRAE)

The description of the project can be found here

Students can apply from 28 February 2024 to 31 March 2024 the ADUM platform

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- ⇨ meeting and events
- ⇨ project call / partnership search
- ⇨ jobs
- ⇨ …

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