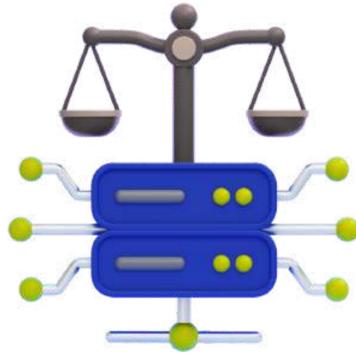


MAKING RUMINANT MICROBIOME DATA GLOBALLY REPRESENTATIVE AND **FAIR**



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INTRODUCTION

Ruminant microbiomes play a key role in livestock production: they influence feed efficiency, animal health, and environmental footprint. However, the microbiome composition depends on the ruminant species, habitat and diet, highlighting the importance of having a good representation of ruminant microbiomes in their local environment to translate research findings into beneficial practices.

Current microbiome datasets are heavily biased toward cattle in high-income countries, limiting their relevance for diverse production systems worldwide.



WHAT PROBLEM DOES THIS ADDRESS?

In a global assessment covering 47,628 microbiome samples from cattle, sheep, goats, yaks, buffalo, bison, and camelids, we found that:



Lack of global representativeness:

- Species such as goats, buffalo, and camelids are under-represented.
- Regions with large ruminant populations (Africa, Latin America, Asia) contribute very few samples.



Incomplete metadata and quality constraints:

- More than 40% of samples lack basic animal information: age, sex, breed, and production system.
- Metadata often lacks standardised language (ontology), making data difficult to reuse or compare.





WHAT SOLUTION WAS IMPLEMENTED AND WHAT ARE THE BENEFITS?

To close these gaps, our study recommends:



Promoting microbiome research to encompass areas beyond the gastrointestinal tract, with a focus on the respiratory, skin and reproductive systems, as well as milk microbiomes associated with animal health and disease. Promoting ruminant microbiome research in under-represented species and regions. This helps adapt microbiome-based innovations to local environmental and genetic contexts.



Ensuring that public microbiome databases require core metadata (species, breed, age, sex, production system) as a mandatory condition for data acceptance.



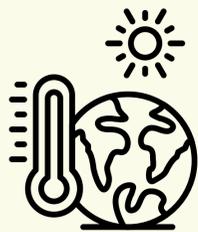
Using livestock-relevant ontologies, such as the Animal Trait Ontology for Livestock (ATOL), to standardise metadata and improve reusability.



Training researchers (PhD students, postdocs, senior scientists) in open data standards and FAIR data principles to increase data quality and accessibility

WHAT ARE THE PRACTICAL BENEFITS?

By improving global microbiome data coverage and quality, farmers, breeders, and policymakers can:



Develop region-specific microbiome strategies to reduce greenhouse gas emissions.



Improve feed efficiency and animal health using tailored microbiome-based solutions.



Enhance livestock resilience and productivity under climate change conditions.

CONCLUSION

For microbiome research to contribute effectively to sustainable livestock production worldwide, improving both the global representativeness and metadata quality of ruminant microbiome data is essential. Ensuring that basic animal information is systematically collected and shared, alongside the adoption of standardised ontologies, will enhance the usability of data for research, innovation, and policy support. This is especially critical for developing regions where livestock production is expanding and where microbiome-based solutions could deliver the greatest impact.

