



HOLOGENOME

Sao Paulo School of Advanced Science 2024

METABOLOMIC APPROACH OF BOVINE LIVER TO EXPLORE BIOMARKERS ASSOCIATED WITH METHANE EMISSION IN BEEF CATTLE

Pâmela Thays da S. Baima¹, Luciana C. A. Regitano, and Daniel R. Cardoso¹

¹Institute of Chemistry of São Carlos, University of São Paulo, São Carlos, SP 13566-590, Brazil.

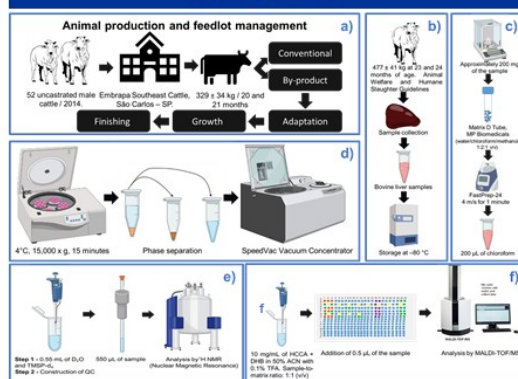
Introduction

Enteric methane emissions pose a significant environmental challenge, prompting Brazil's commitment at the 26th Conference of the Parties (COP 26) in 2021 to reduce methane emissions by 30% by 2030. Given the liver's pivotal role in regulating energy balance and overall metabolic physiology, investigating biomarkers associated with bovine liver metabolism is essential. Both polar and apolar metabolites in the liver hold potential as indicators for discerning the presence of microorganisms linked to methane emission. This comprehensive exploration of the metabolome, known as metabolomics, unravels the activities of metabolites, sheds light on cellular metabolism, and aids in biomarker identification.

Objective

The objective of this study is to apply metabolomics to understand how dietary changes influence the liver metabolome of Nelore cattle and to identify biomarkers related to the mitigation of methane emissions.

Methods



a) Animal production and feedlot management; b) Sample collection; c) Sample preparation; d) Phase separation and concentration of the sample; e) Analysis by ¹H NMR (polar phase); f) Analysis by MALDI-TOF MS (apolar phase)

Results and Discussion

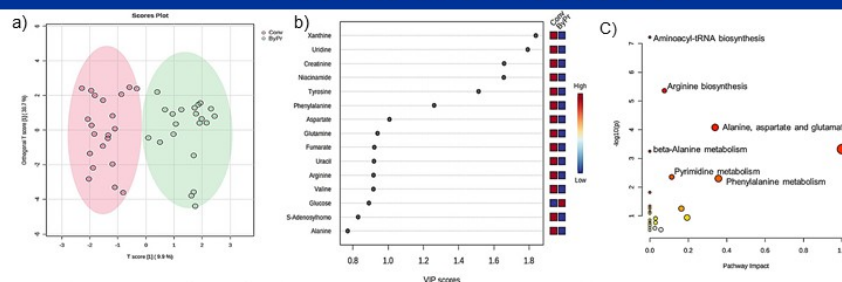


Figure 1: Data Analysis of the Metabolites from 42 liver samples of Nelore cattle : a) OPLS-DA model under different diets calculated to discriminate between Conventional and By-product groups; (b) Variable importance in the projection (VIP) analysis; c) The most relevant pathways that differentiated the Conv liver samples from the ByPr samples, using MetaboAnalyst 5.0.

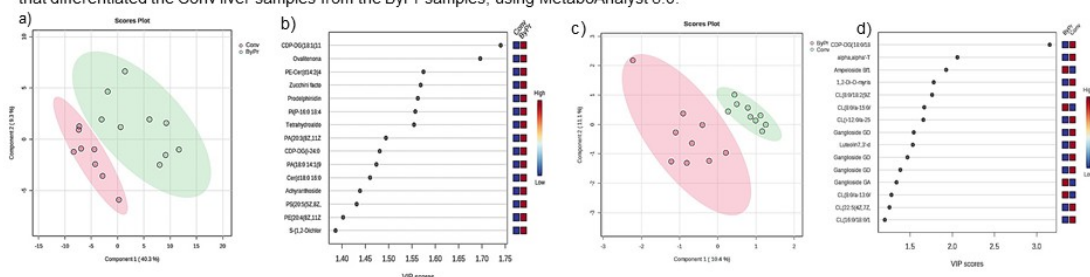


Figure 2: Multivariate Data Analysis of the Metabolites: (a) PLS-DA score plots (Component 1 vs. Component 2) of the metabolite profile of lipid samples from groups 1 and 2. Conv versus ByPr (Class1); (b) VIP score plots from PLS-DA analyses of the liver metabolite profile for Conv versus ByPr cattle(Class1);(c) PLS-DA score plots (Component 1 vs. Component 2) of the metabolite profile of lipid samples from groups 1 and 2. Conv versus ByPr (Class 2); (d) VIP score plots from PLS-DA analyses of the metabolite profile of lipid samples from groups 1 and 2. Conv versus ByPr. *Lipid samples were separated into two class (1 and 2) due to the presence of significantly different metabolites.

Conclusion

This study contributed to the hologenome of Nelore cattle, enabling the discrimination of differences between Conv and ByPr diets, and identifying key metabolites and lipids.

References

GERBER, P. J.; STEINFELD, H.; HENDERSON, B.; MOTTET, A.; OPIO, C.; DIJKMAN, J.; FALCUCI, A.; TEMPIO, G. **Tackling climate change through livestock**: a global assessment of emissions and mitigation opportunities. Rome: FAO, 2013. SYSTEM FOR ESTIMATING GREENHOUSE GAS EMISSIONS AND REMOVALS. Challenges and opportunities for reducing methane emissions in Brazil. [S. l.]: SEEG, 2022. Available at: https://seeg.eco.br/wpcontent/uploads/2023/03/SEEG_METANO_2022_FINAL.pdf. Accessed: July 15, 2024.

Perspectives

The analysis of phenotypes for residual methane emission, residual water intake, and feed efficiency did not reveal significant differences. Therefore, the contemporary group (CG), defined by the weighing group and slaughter group, will be used. These groups will be considered as fixed effects in the MIXED procedure of the SAS statistical software (SAS Institute, Cary, NC, USA, 2011).

Acknowledgment



SÃO PAULO RESEARCH FOUNDATION



Foundation for Research Support and Scientific and Technological Development of Maranhão



METABOLOMIC APPROACH OF BOVINE LIVER TO EXPLORE BIOMARKERS ASSOCIATED WITH METHANE EMISSION IN BEEF CATTLE

Pâmela Thays da S. Baima¹, Daniel R. Cardoso¹, Luciana C. A. Regitano².

¹Instituto de Química de São Carlos, Universidade de São Paulo, São Carlos, SP 13566-590 Brazil. *Correspondence: baima.pamela@usp.br.

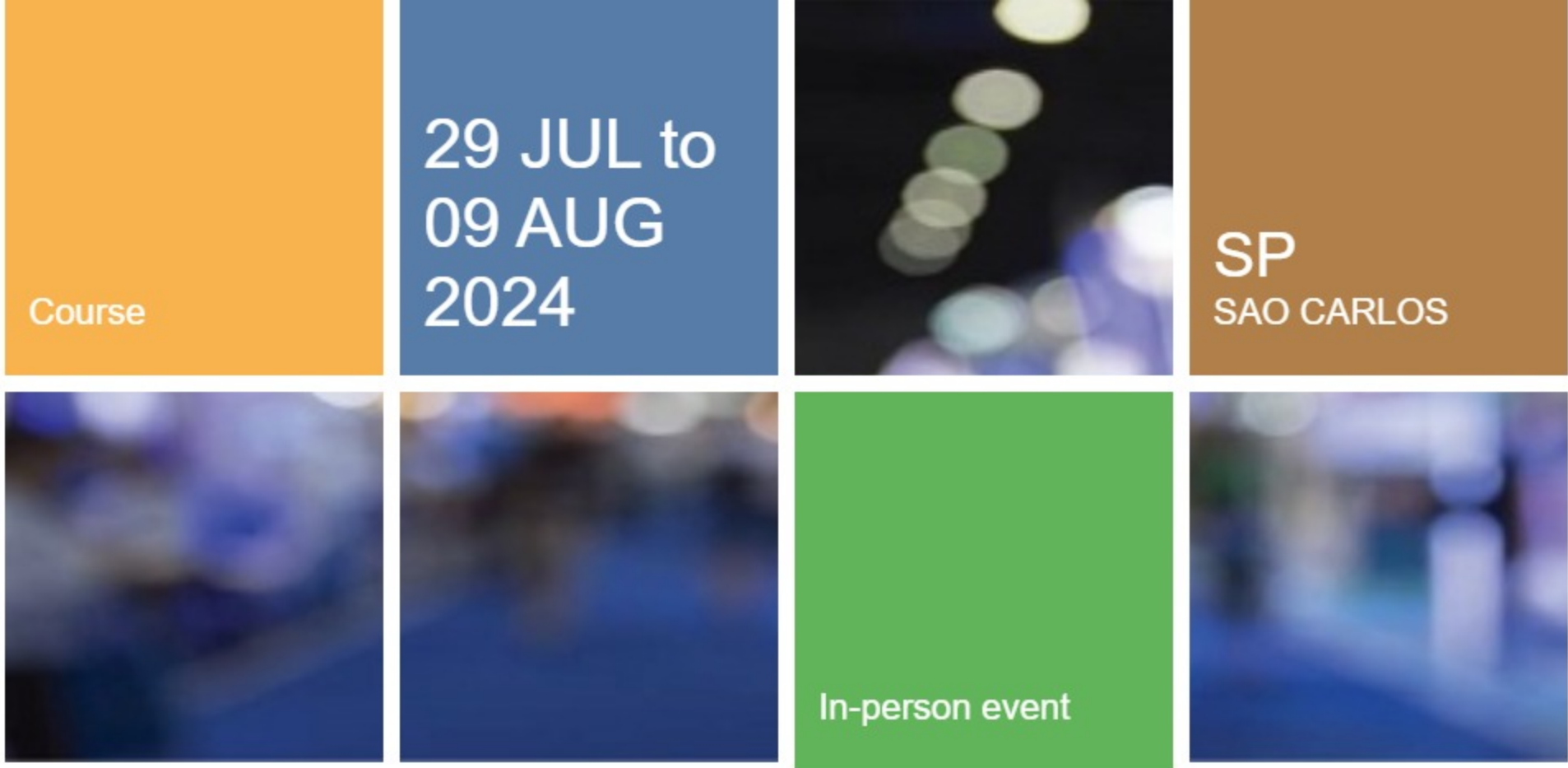
Enteric methane emissions constitute a significant environmental concern, leading Brazil to commit at the 26th Conference of the Parties (COP26) in 2021 to reduce methane emissions by 30% by 2030. As the livestock sector is one of the main contributors to methane emissions, mainly through the process of enteric fermentation of ruminants, it is necessary to use strategies to achieve the goals defined by COP 26. Among the various methods, the manipulation of diet stands out. In this way, it is important to study how modulations in bovine diets cause physiological changes in the organisms of ruminants. Since the liver plays a key role in regulating energy balance and general metabolic physiology, it is essential to investigate the biomarkers associated with the metabolism of the bovine liver. In view of this, this study focuses on the evaluation of polar and apolar metabolites of the Nelore bovine liver to understand how the various nutritional interventions can contribute to the mitigation of methane. A total of 52 liver samples from castrated male bovine animals, *Bos indicus* (Nelore), subjected to various diets, including conventional and by-products-based diets, were analyzed. Extraction procedures have been employed for polar and apolar compounds, and analytical techniques such as nuclear magnetic resonance spectroscopy (¹H NMR) and matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF/MS) have been applied. The data from the polar compounds were collected by ¹H NMR and processed using the Chenomx software, while the data from the apolar components were

gathered by MALDI-MS and handled in R using the MALDIquant package. The lipids were annotated using the CEU 3.0 mass mediator tool. Multivariate and univariate analyses were performed using the software MetaboAnalyst 5.0. The study so far has not found biomarkers, but the analyses carried out have allowed the identification and quantification of metabolites in samples of bovine liver and demonstrated significant differences between the food diets submitted, conventional and by-product.

Keywords: bovine, methane, liver, diets.

Funding Agency: The São Paulo Research Foundation (FAPESP).

Foundation for Research Support and Scientific and Technological Development of Maranhão (FAPEMA).



Course

SÃO PAULO SCHOOL OF ADVANCED SCIENCE ON HOLOGENOMIC DATA ANALYSIS FOR AGRICULTURE

Post 0

The São Paulo School of Advanced Science (ESPCA) brings together scientists and students in short courses to analyze advanced topics in various areas of research, in addition to seeking to promote the attraction of young talents, committed to academic excellence.

Each ESPCA offers short courses on advanced science and technology topics, contributing to the training of participants and creating in the State of São Paulo a world-competitive hub for attracting scientific talent.

The professors who teach subjects at ESPCA are researchers of high global visibility, evidenced through elements such as receiving high-level scientific awards, publications with an impact recognized by the community in the field and leadership in prominent international organizations.

Students participating in the ESPCA must be enrolled in undergraduate or postgraduate courses in Brazil or abroad, being potential candidates for Master's, Doctorate courses or internships as Post-Doctors in higher education and research institutions in the State of São Paulo. Some young doctors may also be accepted.

Students selected to participate in the courses will have the opportunity to present, in poster sessions, the results of their research, discussing the progress of their results with the participating scientists.

The "São Paulo School of Advanced Science in Hologenomic Data Analysis for Agriculture" will provide students and young researchers with an interdisciplinary view of hologenomics and state-of-the-art knowledge on how to analyze and integrate the analysis of different omics. aims to discuss how these tools could improve the development of new agricultural management strategies.

For more information and important dates visit the website.

Support



Bronze Sponsorship



Silver Sponsorship



Gold Sponsorship



Funded by



Organized by



Total workload | 75h
Course | Audience restriction: Open

Venue

Embrapa Southeastern Livestock | Rodovia Washington Luiz Km 234 Fazenda Canchim, Centro, SAO CARLOS - SP
Embrapa Instrumentation | Embrapa Instrumentação Rua XV de Novembro, nº 1.452, Centro, SAO CARLOS - SP

Attachments

Programa_completo_Escola_Fap

Contact

Equipe organizadora do evento
551634115622
hologenomeschool@gmail.com

Keywords

SPSAS