# PORTABLE NIR SPECTROMETER AS A SUSTAINABLE TOOL FOR AUTHENTICITY CONTROL AND TRACEABILITY OF STINGLESS BEE HONEY IN BRAZIL

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COMO CITAR ESSE TRABALHO?

## Resumo

Brazil harbors around 9.14% of the world's 20,027 known bee species, making it the country with the greatest diversity of stingless bees. Meliponiculture has become a key source of income for small producers and an important driver of biodiversity conservation through pollination services. The chemical and sensorial characteristics of stingless bee honey vary considerably depending on the species, botanical origin, and geographic distribution, posing challenges for standardization, certification, and traceability in the honey supply chain. This study aimed to develop and validate a fast, non-destructive, and reliable process for identifying the bee species responsible for honey production, supporting authenticity verification, product traceability, and quality assurance at honey processing facilities. A total of 73 honey samples were analyzed, including *Apis mellifera* ($n$ = 21), *Tetragonisca angustula* (Jataí, $n$ = 34), and *Melipona quadrifasciata* (Mandaçaia, $n$ = 18). Spectra were acquired using a portable near-infrared (NIR) spectrometer (Tellspec, China) operating in the 900–1700 nm range, in reflectance mode. Spectral data were preprocessed using Standard Normal Variate (SNV) and Savitzky–Golay smoothing (15:2), followed by mean-centering and autoscaling. The chemometric model was built using Partial Least Squares–Discriminant Analysis (PLS-DA) with five latent variables, validated by random subset cross-validation (70% training, 30% test). The PLS-DA model achieved 100% accuracy, sensitivity, and specificity in classifying honey samples according to bee species. The confusion matrix indicated no misclassifications among test samples ($n$ = 22). Principal Component Analysis (PCA) and PLS-DA score plots demonstrated clear separation between the three honey groups, confirming that spectral information captured in the NIR region reflects the compositional differences associated with each species. The use of portable NIR spectroscopy proved advantageous due to its speed, low cost, and environmental sustainability, eliminating the need for chemical reagents or complex sample preparation. The developed process allows rapid identification of bee species directly from honey samples using portable NIR spectroscopy combined with chemometric modeling. This innovative approach supports authenticity control, enhances product traceability, and can be readily adopted by honey processing enterprises, contributing to the economic value and credibility of stingless bee honey in Brazil.

## Compartilhe suas ideias ou dúvidas com os autores!

Sabia que o maior estímulo no desenvolvimento científico e cultural é a curiosidade? Deixe seus questionamentos ou sugestões para o autor!

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## Programação

10:10 até 11:10 em 17/11/2025
Salão Real
(https://eventos.galoa.com.br/slacan-2025/calendar/activity/21141)

## Instituições

[1] Empresa Brasileira de Pesquisa Agropecuária, Embrapa Meio Ambiente - Jaguariúna/SP

[2] Entreposto Vida Natural LTDA

[3] Embrapa Semiárido

[4] VTT Technical Research Centre of Finland

## Eixo Temático

- Caracterização Química e Físico-química de Alimentos (FQ)

## Palavras-chave

Brazilian biodiversity

Partial Least Squares Discriminant Analysis (PLS-DA)

Near Infrared Spectroscopy