



CHEMOMETRIC CLASSIFICATION OF PERUVIAN HONEYS FROM BAJO MAYO, SAN MARTÍN, PERU: MULTIVARIATE AND FACTORIAL MODELING APPROACHES

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REMARKS

Determining the botanical and geographical origin of honey remains challenging, making it increasingly important to standardize analytical protocols that verify its quality and identify its floral source, thereby reducing the market for fraudulent and adulterated products. Since honey inherits its color, aroma, flavor, and physicochemical properties from flowering plants, pedoclimatic conditions also influence its composition. Interest in honey analysis has grown to meet regulatory requirements, particularly for monofloral honeys. The objective of the study was to determine the physicochemical and sensorial characteristics of honeys from the Mayo river basin.

MATERIALS AND METHODS

The study was conducted on honey samples collected from the Mayo River basin, located in the northwest of the San Martín region and the northeast of the Amazonas, making it a bi-regional basin. Covering an area of 9,774.25 km², the basin has an elongated biogeographic shape that gradually widens toward the lower reaches of the Gera River. Topographic variations range from 200 to 2,000 meters above sea level, and four distinct climatic environments have been identified. The area experiences rainfall deficits in autumn, winter, and spring, along with high relative humidity.



Samples	Place	Altitude (msnm)	Precipitation (mm/año)	Latitude	Longitude
ZA	Zapatero	286	1200	06° 30' 00"	76° 30' 00"
LM	Lamas	596	1300	06° 29' 05"	76° 22' 23"
JG	Juan Guerra	230	1100	06° 35' 28"	76° 18' 47"
LP	Lamas/Palmas	814	1200	06° 27' 10"	76° 32' 00"
BS	Banda/Shilcayo	350	1243	06° 32' 56"	76° 21' 45"

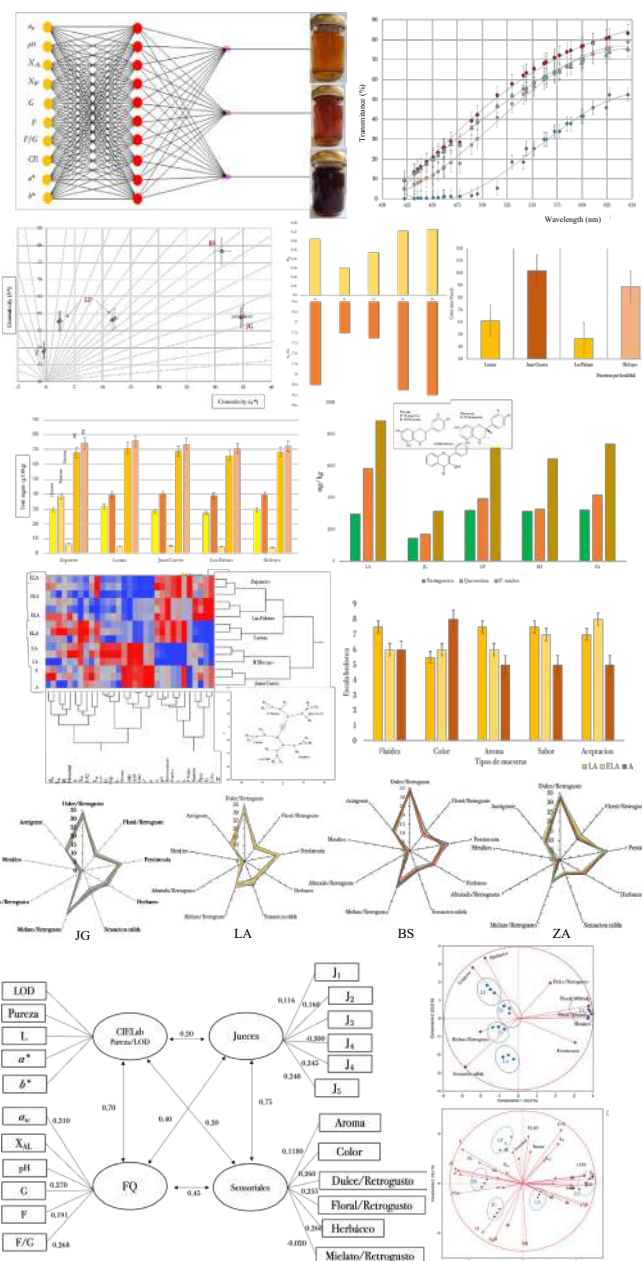
Honey evaluation was performed using Harmonized methods for the following parameters: moisture (X_W); total sugars (X_T), reducing sugars (X_{RE}); free acidity (X_{AL}); glucose (G) and fructose (F); fructose/glucose ratio (F/G) and glucose/moisture ratio (G/H); Tabouret index (IT); color (Pfund); CIELab parameters, color purity (PC), and dominant wavelength (LOD); water activity (a_w); pH; electrical conductivity (EC), diastase index (ID); ash content (XC); total dissolved solids (TCD), Baumé; refractive index (RI) and specific rotation (POR).



Sensory attributes and intrinsic characteristics of the samples were analyzed in relation to their classification using a Probabilistic Neural Network, cluster analysis, discriminant analysis, multiple factor analysis, and PLS-PATH modeling, allowing clear differentiation and classification of the honeys.

RESULTS AND DISCUSSION

The geographic portion of the Mayo River basin is characterized as an Amazonian environment with tropical dry forest (BS-T) in the San Martín region. It features mountainous physiogeographic conditions and hosts a wide range of ecosystems. Flowering occurs throughout the year, with both short and long flowering periods, often presenting dense floral blooms. The mellissopalynological profile of the honey harvested in LA, LP, and ZA revealed them to be multifloral honeys, containing both dominant and significant accompanying pollen grains.



Sensory attributes of honeys from Juan Guerra, Zapatero, Lamas, Banda de Shilcayo, and Las Palmas were analyzed through Quantitative Descriptive Analysis, allowing classification of samples with similar profiles regardless of geographic origin. Probabilistic neural networks, cluster analysis, and PLS-PATH modeling confirmed these groupings and quantified the influence of honey attributes in relation to geographic origin.

Chemometric Classification of Peruvian Honeys from Bajo Mayo, San Martín, Peru: Multivariate and Factorial Modeling Approaches

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Honey is a natural product made mainly from the nectar of flowers; its final quality depends on its botanical and geographical origin. The variability is wide even for honey from the same region. Their botanical and geographical properties is still difficult to determine, so it is increasingly necessary to standardize analysis protocols that contribute to the verification of the quality of this important product of the beehive. This work was structured based on honey samples collected from the Mayo River, located in the northwest of the San Martín region and the Amazon. Physicochemical and sensory properties of fifteen samples of honey from the Mayo River have been evaluated, taking as reference the physicochemical parameters of color, the chromaticity of the CIELab system, pH, free acidity, total sugars, moisture, ash, electrical conductivity, density, and water activity. Additionally, the sensory attributes and intrinsic properties of the honey samples have been related to their classification through a Neuronal Probabilistic Network system, cluster analysis, discriminant, multiple factorial, and PLS-PATH, which have allowed the differentiation and classification of the honey, according to their geographical origin under three categories associated to the Pfund scale in amber, light amber, and extra light amber. The work allowed for the evaluation and study of the physicochemical, chromatic, and sensory properties of Peruvian honeys through correlation analysis, simultaneously examining groups of variables that led to the identification of common structures with defined characteristics, which facilitated the formulation and generation of classification processes.