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Chemical Fingerprinting of Philippine Muscovado Sugar for Authentication and Functional Food Valorization

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Abstract

The global shift toward clean-label, minimally processed foods with added nutritional value has accelerated interest in alternative sweeteners that extend beyond refined sucrose. In this context, muscovado sugar represents a promising functional food ingredient due to its retention of naturally occurring bioactive compounds and minerals [1]. In the Philippines, where sugarcane is a major agricultural commodity, the development of science-driven, value-added muscovado products presents a strategic opportunity for functional food valorization and market differentiation [2]. However, the lack of standardized chemical markers for authenticity and quality, coupled with the risk of adulteration, limits the competitiveness of Philippine artisanal muscovado in global markets. To address this gap, this study employed an integrated metabolomics approach to profile bioactive constituents and establish chemical fingerprints associated with product authenticity and quality. A total of 15 muscovado milling sites were sampled across six municipalities in Antique, the leading muscovado-producing province in Western Visayas. Metabolite profiling using LC–HRMS revealed consistent detection of phenolic acids, including caffeic, chlorogenic, ferulic, syringic, and vanillic acids. These metabolites were associated with strong antioxidant activity, with all samples exhibiting greater than 50% DPPH radical scavenging capacity. Multivariate analysis enabled clear discrimination between artisanal and commercial muscovado, demonstrating distinct metabolite signatures that can serve as robust markers for authenticity assessment. Complementing the non-volatile metabolite profile, headspace solid-phase microextraction GC-MS identified the volatile compounds as furan derivatives. These furans contribute to the characteristic aroma as well as could serve as indicators of the processing conditions and product quality. Overall, this study establishes an integrated metabolomics-based framework for Philippine muscovado authentication and quality assessment, supporting its valorization as a functional food ingredient and strengthening its positioning in the global market.

References

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