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Polyphenol-Rich Philippine Artisanal Chocolates for Functional Food Innovation and Nutraceutical Development

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Abstract

The Philippines, a climatically favorable cacao-growing region in Souteast Asia, holds significant yet underutilized potential in the global functional food sector. Despite the growing demand for nutraceutical-rich cacao products, the chemical composition and biofunctional properties of Philippine artisanal chocolates remain insufficiently characterized [1,2]. This study systematically profiled the polyphenolic composition and evaluated the bioactivities—particularly antioxidant and neuroprotective activities—of selected Philippine artisanal chocolate formulations. Samples were extracted using Accelerated Solvent Extraction (ASE350) with water under controlled high-temperature and pressure conditions. Targeted metabolite profiling was performed using ultra-performance liquid chromatography coupled with electrospray ionization quadrupole time-of-flight high-resolution mass spectrometry (UPLC–ESI–QTOF–HRMS), with complementary quantification using UPLC–ESI–triple quadrupole mass spectrometry (TQMS). Analyses revealed a diverse range of polyphenolic landscape dominated by flavan-3-ols (catechin and epicatechin) and phenolic amides such as clovamide and *N*-coumaroyltyrosine. These metabolites were consistently detected across all formulations, with significant higher abundance in in high-cocoa and cacao nib–enriched products. Functional evaluation demonstrated strong antioxidant activity, with DPPH radical scavenging exceeding 50% at 500 µg/mL and ABTS inhibition ranging from 50–70% at 50 µg/mL. Structure–activity relationship (SAR) analysis indicated that catechol moieties and hydroxyl group positioning significantly enhance antioxidant capacity. Beyond antioxidant effects, chocolate extracts were evaluated *in vitro* for BACE1 inhibition, with results showing >50% inhibition at 1 mg/mL. Preliminary findings on AChE and BChE further indicate that the extracts may modulate key enzymes in the cholinergic pathway associated with Alzheimer's disease. *In silico* molecular docking supported these *in vitro* results, revealing stable hydrogen-bonding and aromatic interactions between clovamide and *N*-coumaroyltyrosine and key residues within the catalytic sites of BACE1, AChE, and BChE. Overall, this study highlights Philippine artisanal chocolates as rich sources of bioactive polyphenols with multifunctional health benefits. These findings further provide critical scientific support for their development as functional foods and nutraceuticals, strengthening their positioning in the global market.

References

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