

Standardization, phytochemical profiling, and bioactivity evaluation of a traditional herbal tea bag formulation

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This study investigates the standardization and bioactivity of a tea bag formulated from a Traditional Herbal Formula (THF) composed of Nelli (*Phyllanthus emblica*), Rasakinda (*Tinospora cordifolia*), and Polpala (*Aerva lanata* var. *rotundifolia*). The formulation met quality standards with a moisture content of 9.0% and total ash of 5.77%. Phytochemical extraction showed higher recovery yields in methanol extract (ME) as 12.7% compared to water extract (WE) as 9.35%. ME exhibited significantly higher Total Phenolic Content (TPC) as 25.61 ± 0.97 mg GAE/g and Total Flavonoid Content (TFC) as 6.31 ± 0.6 mg/g than WE having TPC and TFC values as 8.13 ± 0.13 mg GAE/g and 2.93 ± 0.108 mg/g, respectively. Total Condensed Tannin Content was comparable between ME and WE as 3.60 ± 0.293 mg/g and 3.55 ± 0.324 mg/g, respectively. Antioxidant assays confirmed strong free radical scavenging potential. ME exhibited an IC_{50} of 1118.96 ± 23.33 μ g/mL (ABTS) and 6.67 ± 0.049 μ g/mL (DPPH), whereas WE showed 1729.25 ± 43.85 μ g/mL (ABTS) and 9.22 ± 0.40 μ g/mL (DPPH) comparable to standard BHT 505.66 ± 3.12 μ g/mL (ABTS), 52.04 ± 4.68 μ g/mL (DPPH). The mean absorbance values of FRAP assay obtained from BHT, ME and WE were 0.577 ± 0.065 , 0.595 ± 0.007 , and 0.465 ± 0.009 , respectively. Anti-inflammatory activity was observed with IC_{50} values

of 70.56 ± 1.56 μ g/mL (ME) and 270.16 ± 6.92 μ g/mL (WE), comparable to aspirin 66.90 ± 6.54 μ g/mL. Acetylcholinesterase inhibition was significant, where IC_{50} of ME was 438.92 ± 7.84 μ g/mL and 915.01 ± 1.68 μ g/mL in WE, compared to 137.43 ± 0.89 μ g/mL for donepezil. Alpha-glucosidase inhibition assay showed IC_{50} of 206.73 ± 19.01 μ g/mL in acarbose, 158.77 ± 27.66 μ g/mL in ME, 124.49 ± 10.60 μ g/mL in WE. Alpha-amylase inhibition at 500 μ g/mL showed 21.61% in ME, 12.5% in WE compared to 96% for acarbose. Xanthine oxidase inhibition was highest in ME (43.98% at 500 μ g/mL). Microbiological analysis showed aerobic plate count and yeast/mold counts were within permissible limits. These findings suggest the THF-based tea bag is a potent herbal product with significant antioxidant, anti-inflammatory, and enzyme-inhibitory properties.

Keywords:

Traditional herbal formula; phytochemical analysis; antioxidant activity; medicinal plants; bioassays

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