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Research No.(٦):

Chemical analysis and giardicidal effectiveness of the aqueous extract of *Cymbopogon citratus* Stapf.

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Searching for new effective and safe treatment of *Giardia lamblia* (*G. lamblia*) parasite is mandatory. The aim was to evaluate the in vitro and in vivo effectiveness of an aqueous extract prepared from the leaves of *Cymbopogon citratus* (CcAE) against *G. lamblia* and to reveal the phenolic and antioxidant properties of CcAE.

Methods: CcAE (25, 50, 100, 200, 400, and 500 µg/ml) was in vitro incubated with *G. lamblia* trophozoites in comparison with metronidazole (MTZ 10 and 25 µg/ml). Growth inhibition was evaluated after 3, 24, and 48 h of drug exposure. Infected groups of mice were orally treated for 7 days with CcAE at 125, 250, and 500 mg/kg/day/mouse, in comparison with a group treated with 15 mg/kg/ day/mouse MTZ for the same period. The total phenolic components (TPC), the total flavonoid components (TFC), the 2, 2, diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging activity, and the high-performance liquid chromatography (HPLC) for quantitative and qualitative phenolic content were chemically estimated. After 24 and 48 h of in vitro incubation, the estimated minimal inhibitory concentrations (MIC) were 500 and 400 µg/ml, respectively, and the concentrations that induced 50% growth inhibition (IC₅₀) were 93.8 and 60.4 µg/ml, respectively (P < 0.001). Mice given 500 mg/kg CcAE showed 100% stool clearance of *G. lamblia* stages, similar to

MTZ-treated control group ($P < 0.001$). The TPC was 10.7 ± 0.2 mg GAE/g and the TFC was 23.9 ± 0.3 mg quercetin/g, and the estimated IC50 for DPPH free radical scavenging was 16.4 ± 0.1 mg/ml. HPLC revealed the major phenolic components of CcAE to be carnosic acid, p-coumaric acid, cinnamic acid, quercetin, rutin, and chlorogenic acid. In conclusion, CcAE is significantly effective against *G. lamblia* in vitro and in vivo, and has considerable phenolic and antioxidant properties.