Tropentag, September 16-18, 2026, hybrid conference

"Towards multi-functional agro-ecosystems
promoting climate resilient futures"

Sustainable production of health-promoting compounds from melatonin-elicited cultures of echinacea purpurea

Tehreem Mahmood[1], Muhammad Uzair Javed[2]

[1] *Czech University of Life Sciences, Prague, Department of Crop Sciences and Agroforestry, Czech Republic*
[2] *Czech University of Life Sciences, Prague, Department of Crop Sciences and Agroforestry,*

Abstract

Echinacea purpurea (purple coneflower), a medicinal plant of the *Asteraceae* family, is valued for its antioxidant, anti-inflammatory, and enzyme-modulating compounds, which have potential applications in functional foods and nutraceuticals. Sustainable and controlled production of these bioactives can strengthen nutrition-sensitive value chains and support rural livelihoods while reducing pressure on wild plant populations. Such approaches are particularly relevant in tropical and subtropical regions, where climate change and land-use pressures challenge the availability of high-quality medicinal crops.

This study established *in vitro* callus cultures of E. purpurea using thidiazuron and evaluated melatonin as a bio-elicitor for enhancing biomass, secondary metabolites, and functional activity. Callus cultures treated with 25 μM melatonin exhibited the highest biomass (FW: 208.62 g L ^{1}, DW: 11.87 g L ^{1}), total phenolics (132.8 mg GAE L ^{1}), and flavonoids (585.9 mg QE L ^{1}). Antioxidant activity peaked at this concentration, with 92.7 % DPPH scavenging and 63.2 μg AAE mg ^{1} total antioxidant capacity.

The enzyme inhibitory effects, which modulate lipid and carbohydrate metabolism, highlight the potential of E. purpurea bioactives to be incorporated into functional foods and nutraceuticals that improve dietary quality, support healthier diets in local communities, and help manage obesity and type 2 diabetes: pancreatic lipase (68 % at 50 μM), -glucosidase (22 % at 25 μM), and -amylase (40 % at 10 μM). UPLC-MS profiling confirmed enhanced secondary metabolite production at 25–50 μM melatonin, while amino acid accumulation peaked at 1 μM.

These findings highlight melatonin-mediated elicitation as a biotechnology-based strategy for sustainable production of health-promoting compounds, contributing to agricultural value chains and local livelihoods, and demonstrating a pathway for integrating plant biotechnology into tropical food and health systems.

Keywords: Bioactive compounds, Echinacea purpurea, elicitation, functional foods, health, melatonin, plant biotechnology, sustainability

Contact Address: Tehreem Mahmood, Czech University of Life Sciences, Prague, Department of Crop Sciences and Agroforestry, Kamýcká 1281, 165 00 Praha 6, Czech Republic, e-mail: mahmoodtehreem06@gmail.com