

Effect of ZnO and CuO Nanoparticles on Physiology, Steviol Glycosides and Antioxidant Activities in Invitro Grown Shoots of *Stevia rebaudiana* Bertoni

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Abstract

Objective / Purpose: This study describes the effect of various concentrations (0, 0.1, 1.0, 10, 100 or 1000 mg/L) of ZnO (34 nm in size) and CuO (47 nm in size) nanoparticles on the physiological parameters, steviol glycosides (rebaudioside A and stevioside) content, and antioxidant activities in tissue culture grown shoots of highly valuable medicinal plant, *Stevia rebaudiana* Bertoni.

Material and Methods: ZnO and CuO nanoparticles are synthesized by co-precipitation method, and characterized by X-Ray Diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), UV-Visible Spectrophotometry, Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray (EDX). Shoot nodal explants of *Stevia rebaudiana* undergo direct shoot organogenesis in MS medium containing ZnO and CuO nanoparticles that create oxidative pressure.

Results: The highest percentage of shoots formation (89.6 % and 88.5 %) at 1 mg/L and 10 mg/L of ZnO and CuO nanoparticles, respectively, is obtained that indicates positive influence of these

nanoparticles on the growth of *S. rebaudiana* plant. The high performance liquid chromatography (HPLC) results illustrate significant enhancement of steviol glycosides (almost doubled than control) in micropropagated shoots grown under an oxidative stress of 1 mg/L and 10 mg/L of ZnO and CuO nanoparticles, respectively. Furthermore, the antioxidant activities encompassing total phenolic content (TPC), total flavonoid content (TFC), total antioxidant capacity (TAC), total reducing power (TRP) and DPPH-free radical scavenging activity shows significant increase under the respective concentration of 1 mg/L and 10 mg/L of ZnO and CuO nanoparticles. However, the physiology and biochemistry parameters reveal a sudden decline after crossing the threshold of 1 mg/L and 10 mg/L of ZnO and CuO nanoparticles, elucidating phytotoxicity at this concentration.

Conclusion / Discussion: Hence, it is revealed/concluded that ZnO and CuO nanoparticles can be applied in in vitro batch cultures of *S. rebaudiana* containing upto 1 mg/L and 10 mg/L concentration on respective basis. Further increase of ZnO and CuO nanoparticles concentration causes phytotoxic effect due to the generation of reactive oxygen species (ROS).

Keywords: ZnO nanoparticles, CuO nanoparticles, *Stevia rebaudiana* Bertoni, Steviol glycosides, Physiology, Antioxidant activities

Biography

Dr. Rabia Javed holds a degree of Masters in Philosophy (M.Phil) in Biochemistry/Molecular Biology from Quaid-i-Azam University (QAU), Islamabad, Pakistan, and has a doctorate/Ph.D degree from the same university. Her title of Ph.D research is *"Synthesis, Characterization and Applications of ZnO and CuO Nanoparticles for Biological Activities and Steviol Glycosides Production in Stevia rebaudiana Bertoni"*. She has an experience of working as a Visiting Research Scholar for 1 year under TUBITAK fellowship in Abant Izzet Baysel University, Bolu, Turkey.

Right now, she is serving as Assistant Professor at National University of Medical Sciences, Rawalpindi, Pakistan. It is pertinent to mention here that it's a Federal Public Sector University envisioned to grow as a research led institution providing opportunities of undergraduate and postgraduate education in Medicine, Dentistry, Nursing, Allied Health and Animal Husbandry.

Dr. Rabia has undertaken several technical writing and review projects. She has written 12 international peer reviewed papers and technical articles, out of which she is 1st author in 7 publications. Her impact factor is 26.163. She has also delivered invited lectures and research

papers in multiple national conferences. Additionally, she has over five years of work experience in Nanobiotechnology, Microbiology and Molecular biology.

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