Indian Journal of Biochemistry & Biophysics
Vol. 59, April 2022, pp. 461-467

Roots of *Pennisetum* sp. possess the competence to generate nanoparticles of noble metals

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Received 15 December 2021; *revised 10 January 2022*

Roots of plants have immense reducing potential. Ions of noble metals namely Au^{3+} and Ag^{+} get reduced easily to form Au and Ag nanoparticles (NPs), respectively. Therefore, we hypothesize that plant roots could have potential to form Au-NPs and Ag-NPs. For present investigations, plants of *Pennisetum glaucum* L. were used to evaluate if their roots possess capacity to generate metal NPs. The generation of Au-NPs and Ag-NPs was initially presumed based on colour change, and confirmed by UV-vis spectra, TEM and EDX investigations. Pale yellow Au^{3+} and colourless Ag^{+} solutions turned purple and brown, respectively, by roots of *Pennisetum* sp. within 8 h. Absorption spectra of respective solutions showed plasmon resonance band at 560 nm and 420 nm confirming the presence of Au-NPs and Ag-NPs. TEM coupled with SAED revealed the presence of crystalline spherical NPs in the size range of 5-50 nm in these solutions. EDX further confirmed the presence of Au and Ag as NPs of respective solutions. These results confirmed that the roots of *P. glaucum* possess ideal reducing strength to generate Au-NPs and Ag-NPs exogenously in the aqueous phase.

Keywords: Ag-NPs, Au-NPs, *Pennisetum glaucum* L., Reducing strength, Root system

Grasses possess capacity to tolerate various heavy metals due to immense phytoremediation potential[1]. In general, grasses have greater root surface area as compared to the dicot plants. Rubenstein and co-workers[2] demonstrated the redox activity of roots of intact plants of oat (*Avena sativa*, Poaceae). They further demonstrated that the electron transport complexes prevail in association with plasma membrane at the root surface that are responsible for the redox reactions.

It is well known that precious metal ions in particular that of gold and silver are prone to rapid reduction to form respective atoms which rapidly agglomerate to form nanoparticles[3-5]. Previously, our research team has also specifically demonstrated that Au-NPs and Ag-NPs can be formed with ease through redox reactions under the guidance of biomolecules as well as root surface of several terrestrial plants[4-7].

Au-NPs made in aqueous solution have surface charge to stabilize them against aggregation via electrostatic repulsion and find utility in diverse fields such as drug-delivery, cancer therapy, gene transfer and recognition, biological markers, *etc*.[7-11]. The antimicrobial properties of Ag-NPs make these the most widely used in daily commodities such as creams, lotions, upholstery, shoe insoles, handwash, shampoo, room sprays, air conditioners, washing machines, surface cleaners, in the field of medicine *viz*. artificial teeth, medical catheters, bone coating, wound dressings, surgical instruments and sensing applications such as biolabeling, optical imaging of cancer and detection of DNA sequences[6,11-12].

Minor cereals such as *Pennisetum glaucum* L. (Pearl millet) can be grown under drought prone conditions due to their immense root system[13] besides other drought resistant features. Previously we demonstrated that the plant root surface has the capacity to reduce both Au as well Ag ions with ease under ambient conditions and Rubenstein and co-workers[2] has specifically demonstrated the immense reducing strength of the root system of one of the minor millets (Oat). During present investigations we evaluated if the root system of *P. glaucum* can be exploited for generation of Au-NPs as well as Ag-NPS with ease under ambient conditions. In this communication we are conveying for the first time that root system of intact plants of *P. glaucum*

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