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Extended Abstract

Chitosan Nanoparticles Stabilized with Gallic Acid, Never-Dried Bacterial Nanocellulose, and Alginate Have Biostimulant Potential for Plants †

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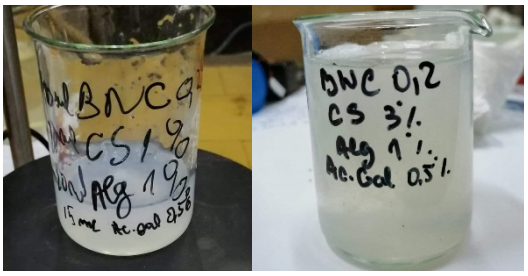
Current plant growth trends coupled with advanced analysis and in-field monitoring are oriented towards new agricultural inputs that protect and stimulate plant development. New nano-formulations sprays are being developed in order to help plants fight biotic and abiotic stress (i.e., osmoprotectants, biostimulants, biopesticides, or elicitors) [1]. The main categories of plant biostimulants include protein hydrolysates, polyamines, aminoacids, other N-containing compounds, seaweed extracts (alginate), botanicals, chitosan, other biopolymers, inorganic compounds (Si, Se), beneficial fungi, humic acids, fulvic acids, and beneficial bacteria [1,2].

A solution of 1% chitosan (CS) was prepared by dissolving it in 1% acetic acid. Further, it was mixed with 0.5% gallic acid that was dissolved in ethanol. The mixture was rigorously shaken using a vortex for 30 min, which allowed the gallic acid to act as an ionotropic crosslinker for chitosan. The nanodispersion was added in a 0.2% bacterial nanocellulose suspension, previously obtained by purification and microfluidization of Kombucha pellicles [3], the cellulosic nanofibrils having the role of a stabilizing net. Alginate was added as a 1% water solution due to its muco-adhesive properties and final stabilization role as a hydrogel containing crosslinked chitosan-gallic acidnanoparticles.

The viscosity of the system with 1% CS was lower, which allows us to recommend it for further spray-drying formulations. The system with 3% CS was homogeneous and more viscous, suggesting a possible application as soil amendment for soils depleted in nutrients. The prepared nanoformulations have potential biostimulant activity due to polyphenolic gallic acid, water retention-releasing characteristics of highly hydrophilic NDBNC, and plant nutrition properties through chitosan and alginate decomposition. An experimental process shown in Figure 1.



(**a**) (**b**)

Figure 1. (**a**) Preparation of chitosan: gallic acid nanoparticles by ionotropic reticulation. (**b**) Stabilization of CS-GA system in an NDBNC-Alginate hydrogel.

The NDBNC-alginate hydrogel contains gallic acid-chitosan dispersed nanoparticles that can be used in their concentrated form as biostimulant hydrogel that can beapplied on soil around plants roots, or in a 100x diluted form for foliar application. These biostimulant nanoformulations can be used for plant growth and protection during drought periods.

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