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Biochemical changes in cyanobacteria during the synthesis of silver nanoparticles

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Abstract

The methods of synthesis of silver (Ag) nanoparticles by the cyanobacteria Spirulina platensis and Nostoc linckia were studied. A complex of biochemical, spectral, and analytical methods was used to characterize biomass and to assess changes in the main components of biomass (proteins, lipids, carbohydrates, and phycobilin) during nanoparticle formation. The size and shape of Ag nanoparticles in the biomass of both types of cyanobacteria were determined. Neutron activation analysis was used to study the accumulation dynamics of the Ag quantity. The analytical results suggest that the major reduction of Ag concentration in solutions and the increase in biomass occur within the first 24 h of experiments. While in this time interval minor changes in the N. linckia and S. platensis biomass took place, a significant reduction of the levels of proteins, carbohydrates, and phycobiliproteins in both cultures and of lipids in S. platensis was observed after 48 h. At the same time, the antiradical activity of the biomass decreased. The obtained results show the necessity of determining the optimal conditions of the interaction between the biomass and the solution containing Ag ions that would allow nanoparticle formation without biomass degradation at the time of Ag nanoparticle formation by the studied cyanobacteria.

Keywords: silver nanoparticles, Spirulina platensis, Nostoc linckia, biomass, biochemical analysis

Résumé

On a étudié les méthodes de synthèse de nanoparticules d'argent par les cyanobactéries Spirulina platensis et Nostoc linckia. On a eu recours à un ensemble de méthodes biochimiques, spectrales et analytiques pour caractériser la biomasse et mesurer les changements de ses principales composantes (protéines, lipides, glucides et

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phycobiline) au cours de la formation des nanoparticules. On a déterminé la taille et la forme des nanoparticules d'argent dans la biomasse des 2 types de cyanobactéries. L'activation neutronique a été utilisée pour analyser la dynamique d'accumulation de l'argent. Les résultats des analyses indiquent que la principale diminution de la teneur en argent dissous et sa hausse dans la biomasse surviennent dans les 24 premières heures des expériences. Dans cette période, il n'y a eu que des changements mineurs de la biomasse de N. linckia et S. platensis. Or, après 48 heures, il y a eu diminution des taux de protéines, de glucides, de phycobilioprotéines dans les cultures liquides et de lipides chez S. platensis. Dans la même période, l'activité anti-radicalaire de la biomasse a décliné. Les résultats obtenus mettent en relief la nécessité d'établir les conditions optimales soutenant l'interaction entre la biomasse et la solution contenant des ions d'argent, qui permettrait la formation de nanoparticules sans dégradation de la biomasse au moment de la formation de nanoparticules d'argent chez les cyanobactéries étudiées.

Keywords: argent nanoparticules, Spirulina platensis, Nostoc linckia, analyse biochimique

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