Microalgae as possible silver "nanofactories"

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***Abstract* — Several strains of microalgae *Sprirulina platensis, Nostoc linckia* and *Porphyridium cruentum* were studied to assess their ability of silver nanoparticles formation. In the experiments the synthesis of nanoparticles in silver nitrate solution was carried out as during the initial cell cultivation as well as in harvested (dead) microbial biomass suspended in silver nitrate solution. The time dependences of silver nanoparticles production process for each strain were established. A variety of spectral and analytical methods was used to characterize the obtained silver nanoparticles: UV-vis spectrometry, scanning electron microscopy (SEM) with energy-dispersive analysis of X-rays (EDAX), neutron activation analysis (NAA), and atomic absorption spectrometry (AAS). It was shown that the produced bacterial biomass with silver nanoparticles can be used for industrial as well as medical and pharmaceutical purposes.**

***Index Terms* — analytical and spectral methods, microalgae, nanoparticles, silver.**

I. INTRODUCTION

Metal nanoparticles have received considerable attention in recent years because of their unique properties and potential applications in catalysis, plasmonics, optoelectronics, biological sensor and pharmaceutical applications [1-3]. Various microorganisms (bacteria, yeast, fungi) are known to synthesize silver nanoparticles [4, 5]. The ability of microalgae, *Sprirulina platensis* and *Nostoc linckia* to produce silver nanoparticles was studied. The preliminary results of the study are presented.

II. MATERIALS AND METHODS

To carry out the experiment, algological pure cultures of *Spirulina platensis* CNM-CB-02 strain and *Nostoc linckia* from the Institute of Microbiology and Biotechnology, Academy of Sciences of Moldova were used. Cells of microalgae were grown as described elsewhere [6]. The harvested mycelial mass was then resuspended in 250-ml Erlenmeyer flasks in 100 ml of 100 mg/L aqueous $AgNO_3$ solution at room temperature, shaking for different time intervals (1−3 days).

UV-vis Spectrometry

The UV-vis spectra of the samples were recorded on a "T80^{+}" spectrophotometer (GBC Scientific Equipment Pty Ltd, Australia, wavelength range 190-1100 nm).

III. RESULTS AND DISSCUTIONS

Addition of microalgae biomass to a silver nitrate solution led to the appearance of red brown color in the solution after 24 hours for *Nostoc linckia* and yellowish brown for *Spirulina platensis* indicating formation of silver nanoparticles.

The UV-Vis absorption spectra of the studied microalgae are shown in Fig. 1 and Fig. 2. The presence of the silver surface plasmon resonance (SPR) peak at ~ 438 nm confirms the silver ion reduction from Ag(0) to Ag(0). The intensity of the peak increased as a function of the reaction time. As it is known, the position of the plasmon adsorption of silver nanoclusters strongly depends on the particles size, dielectric constant of the medium and the surface-adsorbed species. According to Mie´s theory, only a single SPR band is expected in the adsorption spectra of spherical nanoparticles, whereas anisotropic particles could give rise to two or more SPR bands depending on the shape of the particles [7]. In the present case a single band was observed that gives evidence for spherical shape of silver nanoparticles

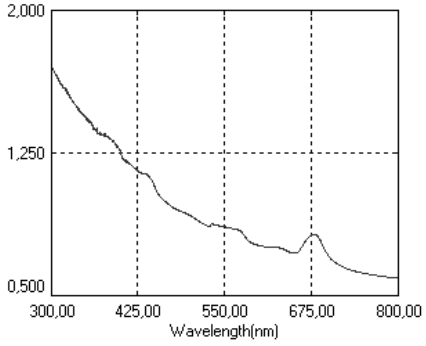

Fig. 1. UV-Vis spectra of *Nostoc linkia* suspension after 24 hours of reaction with

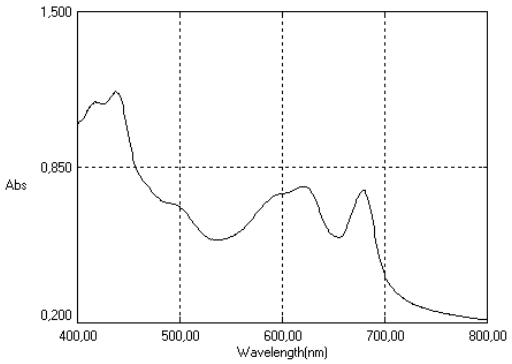

Fig. 2. UV-Vis spectra of *Spirulina platensis* suspension after 24 hours of reaction with

The cell wall of microalgae contain functional groups within biomolecules (amino, carboxylic, phosphate, thiol and other) the main binding sites of metal ions.

IV. CONCLUSION

The preliminary results of the performed investigations show that the studied microorganisms are capable of producing silver nanoparticles. In the near future obtained biological samples will be analyzed using SEM, EDAX AAS and NAA techniques.

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