IN VIVO ACCUMULATION OF BIOFUNCTIONALIZED AgNPs USING SPIRULINA

Cepoi L.[1], Zinicovscaia I.[2,3,4], Rudi L.[1], Chiriac T.[1], Peshkova A. [2], Cepoi A.[1], Grozdov D.[2]
[1]*Institute of Microbiology and Biotechnology, Republic of Moldova*
[2]*Department of Nuclear Physics, Joint Institute for Nuclear Research, Russian Federation*
[3]*Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering, Romania*
[4]*Institute of Chemistry, Republic of Moldova*
e-mail: cepoililiana67@gmail.com

CZU:57.085:579.6 https://doi.org/10.52757/imb22.01

The 4.7 nm polyethylene glycol-stabilized AgNPs were functionalized with spirulina culture during a cultivation cycle. Experiments with laboratory animals were carried out at the Institute of Physiology and Sanocreatology, the Laboratory of Physiology of Stress, Adaptation and General Sanocreatology, and in the Institute's vivarium. AgNPs were administered to animals of the experimental group at a dose of 1 μg Ag/day/animal. Laboratory animals were divided into several groups: two control groups: rats normally kept without food additives and rats fed with spirulina biomass; and two experimental groups: rats treated with silver nanoparticles and an animal group treated with functionalized silver nanoparticles using spirulina. The experience included an administration period of 28 days followed and a 28 days clearance period. Ag was determined by neutron activation analysis (NAA) in different organs after the animals were sacrificed. In the experimental group treated with AgNPs, the maximum concentrations of 0.145-0.150 μg/g Ag were determined in brain, liver and kidney tissues. The concentration of 0.09 μg/g Ag was determined in the spleen. In this case, no accumulation of silver was found in testicular and ovarian tissues. For AgNP-Spirulina, the highest content of 0.136 μg/g silver was determined in the kidneys. Regardless of the type of nanoparticles, one of the pathways for their elimination is the renal one. In animals treated with functionalized AgNPs, silver was determined in the brain tissue at a concentration of 0.113 μg/g. The difference between the bioaccumulation of AgNPs and AgNP-Spirulina in the brain was insignificant, which indicated the ability of nanoparticles to cross the blood-brain barrier and the lack of the effect of enhancing the bioavailability of AgNPs functionalized with spirulina biomass. The content of 0.07 μg/g Ag was determined in the spleen, which corresponds to the value determined in the liver. The silver content determined as a result of the administration of functionalized AgNP-Spirulina in the liver was twice lower than that of silver in the non-functionalized nanoparticles accumulated in the organ. If this was not an increase in the bioavailability of silver nanoparticles, then the relatively low value of AgNP-Spirulina in the liver could be the result of their rapid metabolism. Silver nanoparticle content of 0.085 μg/g was determined in testicular tissue as a result of the administration of functionalized AgNP-Spirulina. This result may be due to the affinity of the tissue in division for some components of the spirulina biomass. This property of AgNP-Spirulina can be further analyzed for practical purposes, as well as the effect of the lack of functionalized nanoparticles in ovarian tissue. Silver was determined in the organs of animals subject to a clearance period of 28 days. In the experimental variant of AgNPs administration, at the expiration of the recovery time, silver was determined in the brain and liver. Thus, in the brain tissue, the Ag content was 0.097 μg/g, which was 2/3 of Ag concentration established as a result of the administration of nanoparticles for 28 days. Then, 24% of the amount of accumulated silver remained in the liver. For AgNP-Spirulina, the absence of nanoparticles in tissues (liver, spleen, kidneys, testicles) was found, except for the brain. The content of silver nanoparticles in brain tissue taken from the animals subject to clearance period was 0.093 μg/g. The obtained result confirms the impossibility of the return path across the blood-brain barrier.

It has been established that AgNPs functionalized with spirulina acquire new biological properties, different from those of non-functionalized AgNPs, and consequently new areas of application.

The scientific results were obtained within the project 20.80009.5007.05 „Biofunctionalized metal nanoparticles - obtaining using cyanobacteria and microalgae" funded by NARD, Republic of Moldova.