CPPC 2024
2nd Canadian Peptide and Protein Community Virtual Symposium
DECEMBER 16, 2024 | ONLINE

Aggregation of silver nanoparticles in presence of bovine serum albumin

Paula Sofía Rivero (1) and Paula Verónica Messina (2)
(1) Departament of chemistry, Universidad Nacional del Sur, Bahia Blanca, Argentina.
(2)Departament of chemistry, Universidad Nacional del Sur, INQUISUR-CONICET, Bahía Blanca, Argentina.

INTRODUCTION & AIM

Nanotechnologies have garnered significant attention in the scientific community due to their applications in various areas of medicine. In particular, silver nanoparticles (Ag-NPs) are noteworthy for their antibacterial and surface plasmonic properties, which depend on their shape anisotropy. Understanding the interactions of Ag-NPs with biomolecules in biological systems is essential for the safe use of new treatments involving these materials. For this reason, we study serum albumin (BSA), the most abundant protein in blood, which plays key roles such as regulating pH, solubilizing certain drugs, and transporting pharmaceutical agents. Examining the behavior of nanoparticles with albumin (Ag-NPs/BSA) can provide valuable insights into their pharmacological effects. [1]

METHOD

Silver nanoparticles Ag-NPs with specific localized resonant surface plasmon was synthesized previously by the group. Two types of Ag-NPs dispersions were examined: spherical and prism suspension. Nanoparticles were in contact with protein solutions to finally evaluated the interactions. This protein solution was freshly prepared by dissolving the protein in the buffer (PBS, pH 7.4). We have prepared protein's solutions within the normal limits in blood plasma (35mg/mL). In this work, we have confirmed that the presence of prism-shaped Ag-NPs and spherical Ag-NPs induces changes in the protein structure, that include aggregation. The technologies used include Fourier Transform Infrared Spectroscopy (FTIR), Small-Angle X-Ray Scattering (SAXS), and Transmission Electron Microscopy (TEM) to study these interactions.

RESULTS & DISCUSSION

In the spectrum FTIR (figure 1) a peak near 1651 cm^{-1} can be observed, to BSA, associated with primary amides with α-helix structures, and another peak near 1543 cm^{-1}, related to secondary amides and β-sheet structures. In the presence of spherical Ag-NPs, both peaks are present with a slight shift in wavenumbers and a minor difference in the shape of the signals. This could be associated with modifications in the β-sheet secondary structure. In the presence of prism Ag-NPs, both peaks appear at the same wavenumbers, showing no significant differences compared to the BSA spectrum. This indicates that no modifications occurred in the secondary structure of the protein.[2]

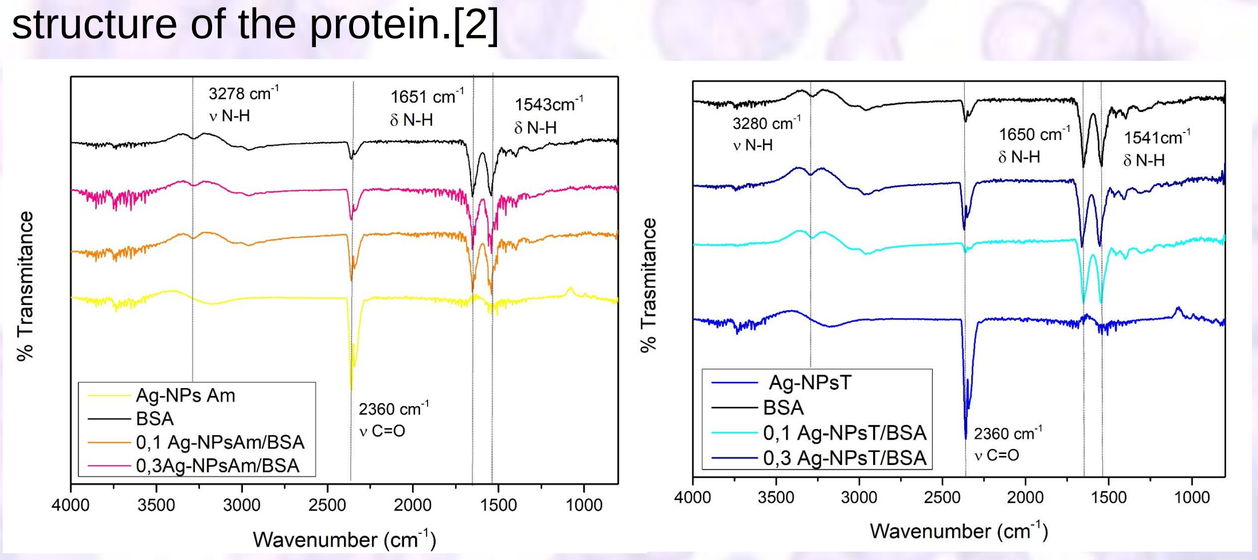
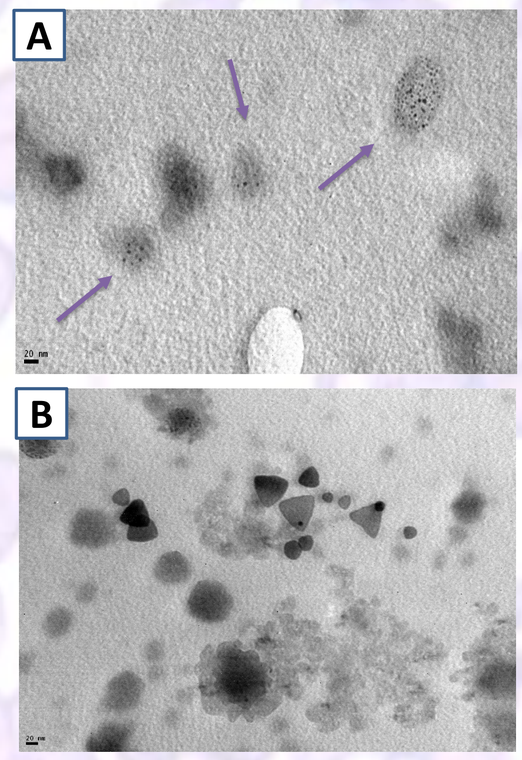


Figure 1. FTIR spectra of NPS/ BSA systems at different nanosilver amount: **(A)** Sphere - like NPs and **(B)** Prism - like NPs.

SAXS study (figure 2) was used to study type of interactions present. Blood proteins and Ag-NPs present attractive interactions on their own. In Ag-Nps/BSA solutions attractive interactions are lower than Ag-NPs itself but higher than blood proteins; this may be due to the agglomeration of the nanoparticles in the presence of the protein have seen stabilized.

Furthermore, in the SAXS intensities significant differences can not be observed between different Ag-NPs morphologies and protein solutions. By TEM, the aggregated state of the systems' AgNPs/BSA was confirmed.



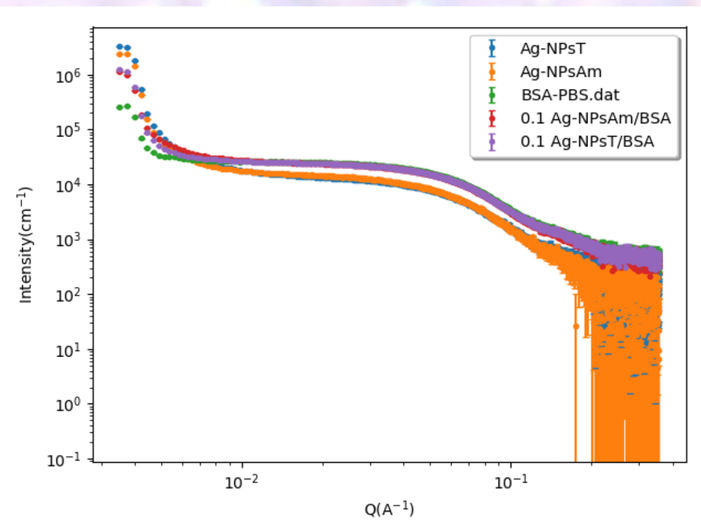


Figure 2. SAXS intensities of sphere- and prism- Ag-NPs with BSA.

Figure 3. TEM BSA in the presence of **(A)** sphere- and **(B)** prism-like Ag-NPs.

CONCLUSION

AgNPs isotropic and anisotropic interacted with BSA through attractive interactions.

REFERENCES

[1] http://dx.doi.org/10.1016/j.molliq.2016.02.103
[2] Bovine serum albumin interacts with silver nanoparticles with a "sideon" or "end on" conformation Nandita Dasgupta a, 1, Shivendu Ranjan a, b, c, **, 1, Dhabaleswar Patra d,Priyanka Srivastava e, Ashutosh Kumar f, Chidambaram Ramalingam