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Changes in Bovine Serum Albumin (BSA) conformation in presence of silver nanoparticles (AgNPs)

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INTRODUCTION & AIM

Blood proteins are the first biological components to interact with a material when it is introduced into an organism. Any alteration in the three-dimensional structure of these proteins can compromise their function. Moreover, the biological response to a material is significantly influenced by protein adsorption — not only in terms of the amount, but also the type and structural conformation of the proteins involved [1]. Silver nanoparticles (AgNPs), on the other hand, are biomaterials with promising properties for medical applications. Motivated by this, we set out to study the behavior of a system composed of bovine serum albumin (BSA) and AgNPs.

In this work, we employed density and speed of sound measurements to calculate specific volume and adiabatic compressibility. In parallel, we used dynamic light scattering (DLS) and fluorescence spectroscopy to gain insights into protein conformation.

METHOD

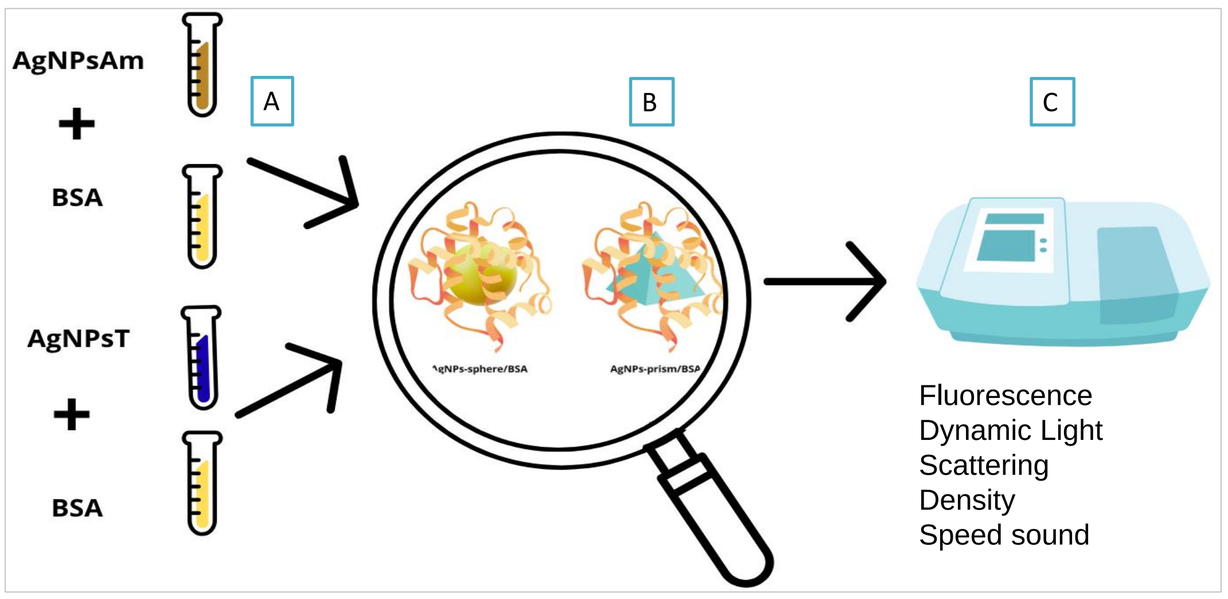

Figure 1. Scheme of experiments. BSA bovine serum albumin. AgNPsAm: sphere-like silver nanoparticles. AgNPsT: prism-like silver nanoparticles.
A) Preparation of solutions
B) BSA in contact with AgNPs
C) Data analysis

Compressibility and volume calculation

$$\varphi_v = \frac{1}{\rho_0} + \frac{\rho_0 - \rho}{c_p \rho_0} \quad (1)$$

$$\beta = \frac{1}{\rho u^2} \quad (2)$$

$$\varphi_k = \beta_0 \left(2\varphi_v - 2[u] - \frac{1}{\rho_0}\right) \quad (3)$$

Where:
ρ is the relative densities of NPs / BSA solutions.
ρ0 is the relative density BSA
cp is the protein concentration
φv is the apparent specific volumen
β is the adiabatic compressibility.
u is the sound velocity of NPs/BSA solutions
*u*0 is the sound velocity of BSA
φk is the partial specific apparent adiabatic compressibility
[*u*]= (*u*-*u*0)/cp *u*0

RESULTS & DISCUSSION

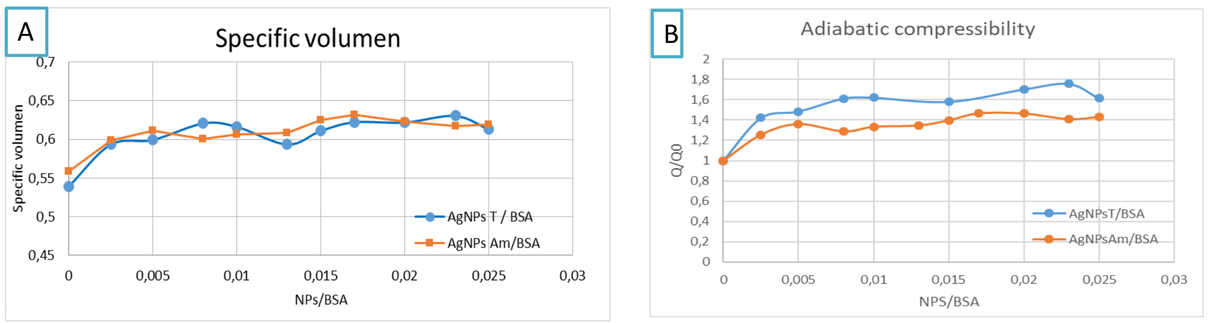

Figure 2 (A) Apparent specific volumen and (B) Adiabatic compressibility in presence of different amount of sphere-like nanoparticles (orange line) and prism-like nanoparticles (blue line).

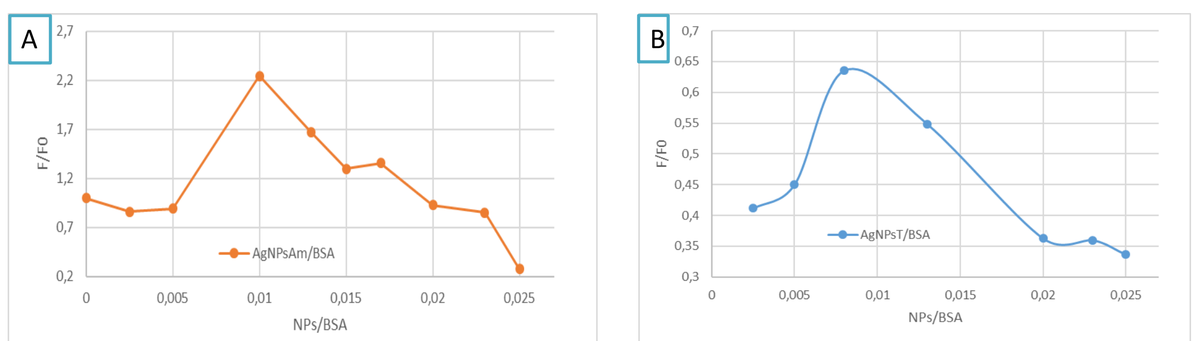

Figure 3. Relative fluorenscence intensity in presence of different amount of (a) sphere-like nanoparticles and (b) prism-like nanoparticles.

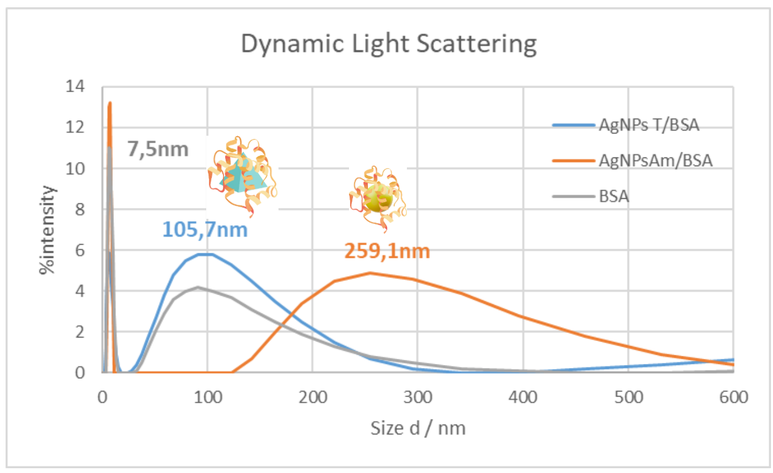

Figure 4. DLS measurements in presence of different amount of sphere-like nanoparticles (orange line) and prism-like nanoparticles (blue line).

CONCLUSION

- Volumetric and compressibility propierties are correlates with partial loss of BSA periodic structure [1].
- The dependence of the Trp fluorescence can be considered as a consequences of a balance between metal enhanced fluorescence and Surface energy transfer [2].
- Signs of agreggations agree with a direct interaction between BSA and silver nanoparticles [3].

FUTURE WORK / REFERENCES

[1] El Kadi, N., et al., *"Unfolding and refolding of bovine serum albumin at acid pH: ultrasound and structural studies".* Biophysical journal, 91(9), 2006. p. 3397-3404.
[2] Caires A, Costa L and Fernandes J *"A close analysis of metal-enhanced fluorescence of tryptophan induced by silver nanoparticles: wavelength emission dependence"* Open Chem. 11 (2013) 111–5
[3] Manik Waghmare & Bipin Khade & Pradip Chaudhari & Prabhakar Dongr. *"Multiple layer formation of bovine serum albumin on silver nanoparticles revealed by dynamic light scattering and spectroscopic techniques"* J Nanopart Res (2018) 20