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Low-Concentration Hematology Behaviour of NIR-sensitive Silver Nanoplates: Isotropic against Anisotropic Morphologies

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INTRODUCTION & AIM

Understanding the hematological behavior of near-infrared (NIR) responsive plasmonic nanoparticles is crucial for their medical applications. Theses optical properties are usually exhibited in nanostructures. However, low concentrations of nanoparticles (NPs) may cause toxicity in biological environments through interactions with biomolecules. Plasma proteins have implications for hemostasis, thrombosis, and inflammatory responses. This study focuses on the interactions of isotropic and anisotropic silver nanoparticles (AgNPs) with a model plasma protein, bovine serum albumin (BSA), and their effects on red blood cells (RBCs) and clotting time. The results will help in the development of new NIR-light sensitive devices and/or preparations loaded with NIR-light responsive nanosilver that can take advantage of their favourable properties with a safe use of them [1].

METHOD

AgNPs with specific localized resonant surface plasmon was synthesized previously by the group. Two types of AgNPs dispersions were examined: spherical and prism. 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). Protein solutions were prepared within the normal limits in blood plasma (35-50 mg mL^{-1}). This interaction was study using UV-Vis spectrophotometry and molecular 3D fluorescence spectroscopy. Also was employed transmission electron microscopy (TEM) to analyzed any change in the size and morphology of the particles.

Fresh blood was used to establish interaction parameters like changes in cell morphology. The study was carried out by incubating entire heparinized blood with AgNPs. The release of red blood cell content, particularly lactate dehydrogenase (LDH) activity, is assessed as an indicator of cell membrane rupture [2]. The concentration of LDH was obtained by a UV–Vis-NIR spectrophotometry. The influence of AgNPs on blood coagulation times was investigate by activated partial thromboplastin time (APTT), and prothrombin time (PT) test kits. Previous to additions of test, fresh blood was incubated with and without nanoparticles.

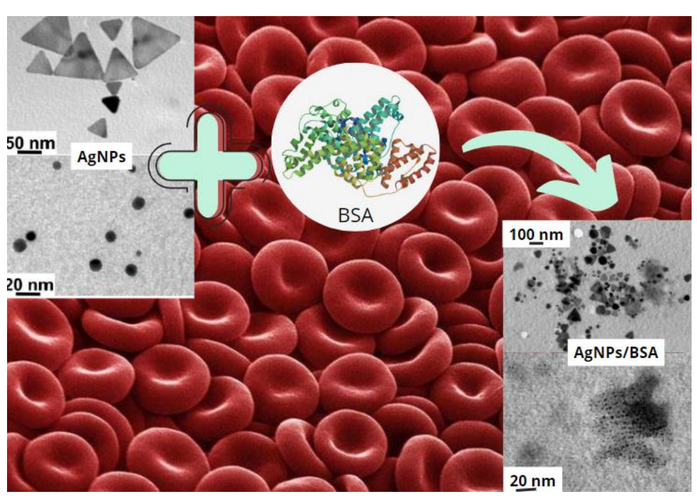

Figure 1. Scheme of metod interactions sphere- and prism-AgNPs with BSA.

RESULTS & DISCUSSION

UV-Vis (Figure 2) was used to study the chemical environment of interface AgNPs/BSA. The results did not show changes in the prism-shaped particles at different concentrations, but the sphere-shaped particles showed decreased intensity wich is related to the presence of the altered protein corona conformation [3]. Fluorescence revealed that nanoparticles can induce the enhancement and quenching of protein emission, possibly due to conformational changes in the protein structure, Figure 3 [4]. By TEM, the aggregated state of the systems' AgNPs/BSA was confirmed.

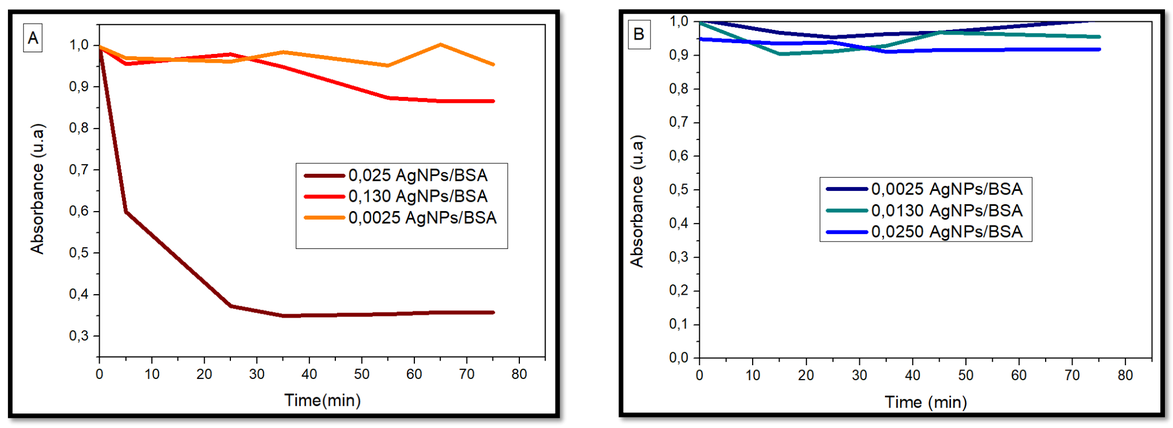

Figure 2. Time dependence of protein absorbance variation of AgNPs/ BSA systems at different nanosilver concentrations: **(A)** Sphere - like NPs and **(B)** Prism - like NPs.

AgNPs showed no RBCs shape changes compared to controls. LDH assays indicated minimal enzyme release, within normal ranges. Isotropic AgNPs increased LDH release compared to anisotropic counterparts. AgNPs had no significant effect on plasma coagulation time for intrinsic or extrinsic pathways. Interaction with plasma proteins may activate the coagulation cascade, but AgNPs showed no impact on coagulation time.

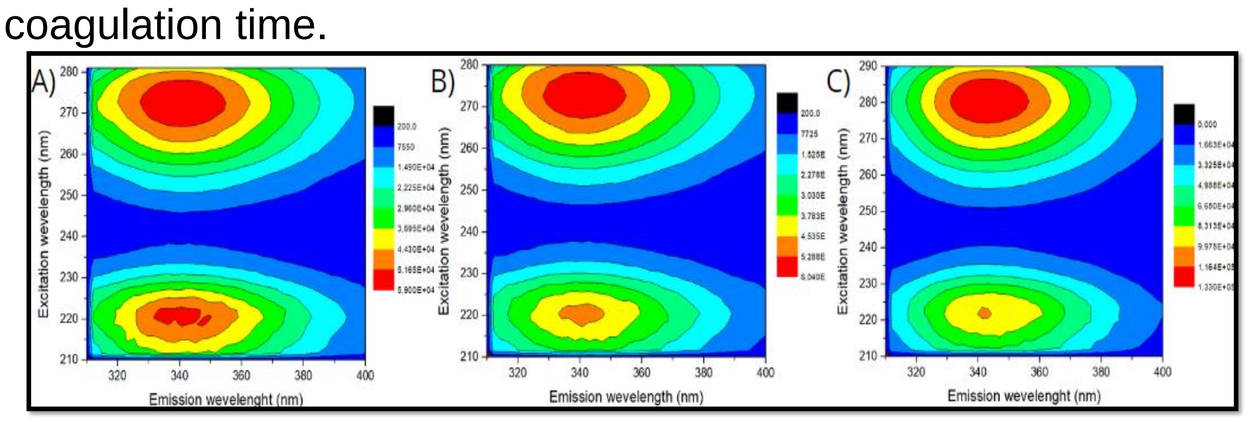

Figure 3. Contour plot of the fluorescence intensity spectra of BSA **(A)** and BSA in the presence of **(B)** sphere- and **(C)** prism-like AgNPs.

CONCLUSION

AgNPs isotropic and anisotropic interacted with BSA at different ways. However, no toxicological effects were recorded. That's allow us to continue their future exploration in biomedical developments.

FUTURE WORK / REFERENCES

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