Biocompatibility evaluation of selenium nanoparticles as promising delivery nanosystems

R. Barbir[1]. B. Pem[1]. A. Selmani[2]. I.Vinković Vrček[1]

[1] Analytical Toxicology and Mineral Metabolism Unit. Institute for Medical Research and Occupational Health. Zagreb. Croatia
[2]Laboratory for Biocolloids and Surface Chemistry. Division of Physical Chemistry. Ruđer Boskovic Institute. Zagreb. Croatia
E-mail:rbarbir@imi.hr

INTRODUCTION

Selenium nanoparticles (SeNPs) emerged recently as a more efficient and safer nanomaterial for biomedicine [1]. Selenium is involved in many vital functions in the body. including antioxidant. immunomodulatory. antitumor and anti-infective activities [1]. Many studies have claimed that SeNPs exhibit lower toxicity. higher bioavailability and stronger biological activities than inorganic or organic selenium compounds [1]. Here. we present the preparation and hemocompatibility assessment of SeNPs functionalized with three different coating agents - non-ionic polyvinylpyrrolidone (PVP). positively charged poly-L-lysine (PLL). and negatively charged polyacrylic acid (PAA).

MATERIALS AND METHODS

Synthesis of SeNPs was performed by the reduction method. which gained stable SeNPs with well-defined properties. Size distribution and surface charge were obtained by dynamic and electrophoretic light scattering. respectively (Table 1). SeNPs were visualized by transmission electron microscopy (Figure 1.).

Their hemocompatibility (Figure 2) was evaluated using a hemolysis assay according to the protocol of National Cancer Institute (NCI) [2]. Blood samples were diluted with phosphate buffer solution (PBS) and differently coated SeNPs (concentrations of 150 and 300 mg/L) were added in solution. After incubation and centrifugation. supernatant and cyanmethemoglobin reagent were mixed. The absorbance at 530 nm was determined and the percentage of hemolysis was calculated. For comparative purposes. sodium selenite (Na_2SeO_3) was used as control.

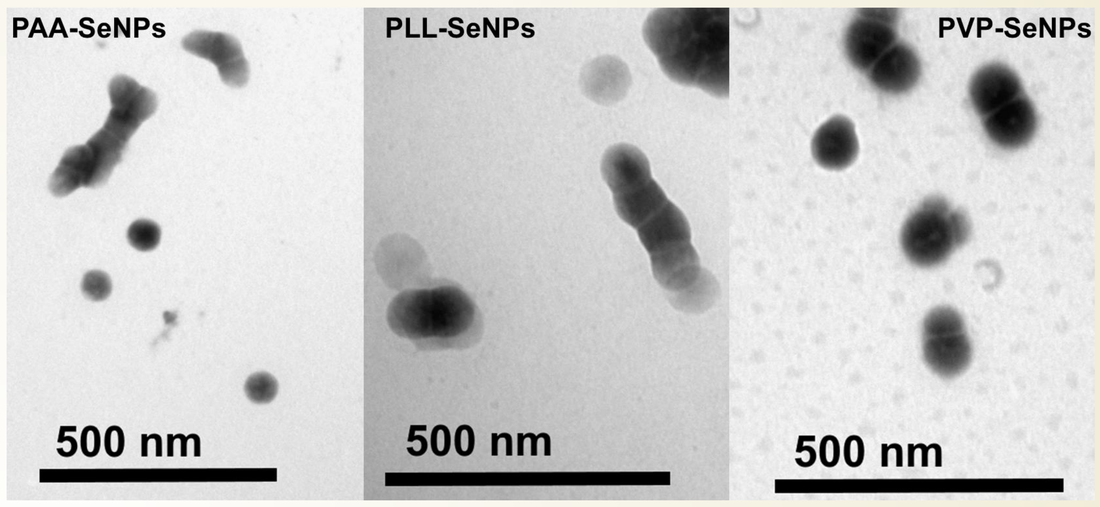

Figure 1. TEM micrographs of SeNPs.

Table 1. Hydrodynamic diameters (d_H) and corresponding volume percentages and zeta potential (ζ) for PVPSeNP. PLLSeNP and PAASeNP in ultrapure water (UPW) at 25˚C.

Nanoparticle	d_H (nm)	% Volume	ζ (mV)
PVP SeNP	97.6 ± 0.6	100	–32.9 ± 0.6
PLL SeNP	112.1 ± 1.1	100	25.9 ± 0.4
PAA SeNP	157.0 ± 32.1	72.1	–42.2 ± 0.8

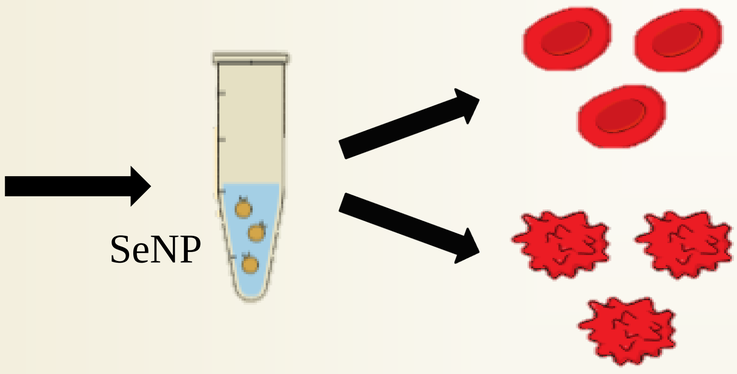

Figure 2. Scheme for measuring *in vitro* hemolysis of SeNPs.

RESULTS

Obtained results showed dose-dependent hemolytic behavior of SeNPs. The PAA-coated SeNPs showed the highest extent of hemolysis (27% erythrocytes at 33 mg Se/L) followed by PVP-SeNPs. while PLLSeNPs did not cause hemolysis at any tested concentration.
In general. results demonstrated low hemolytic properties of SeNPs. indicating their biocompatibility. which is advantageous for biomedical applications.

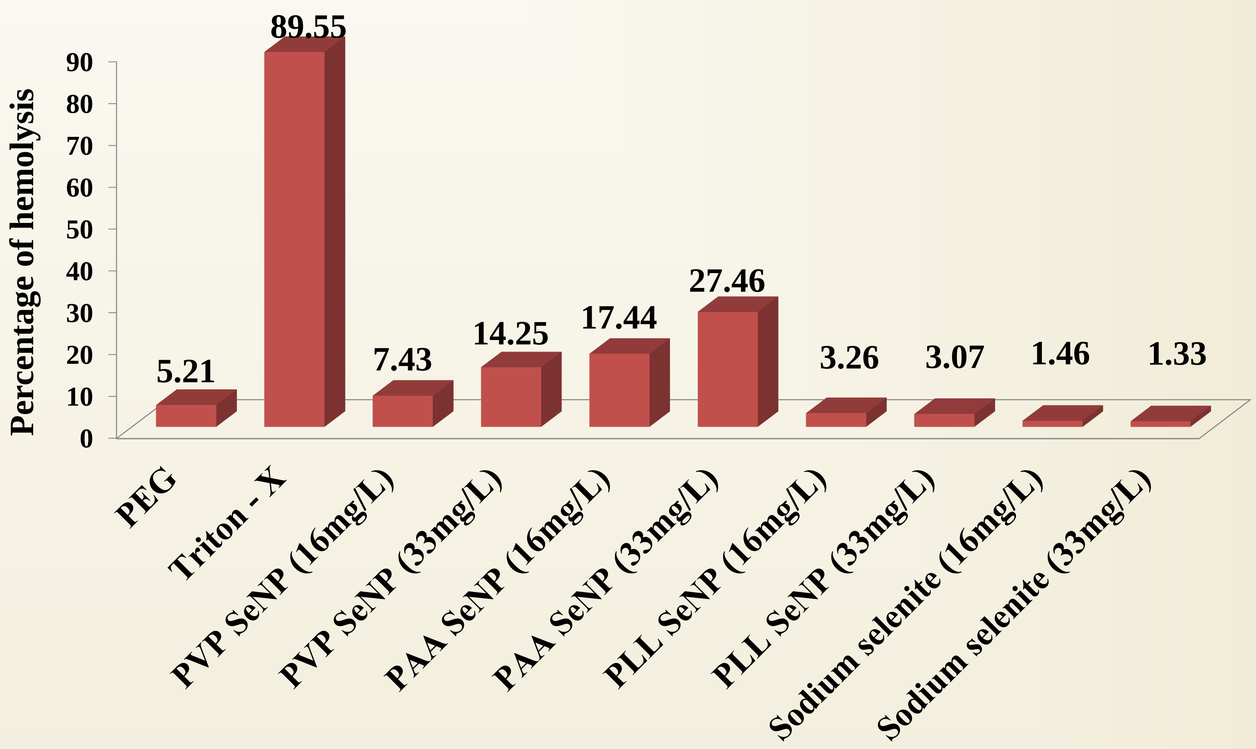

Figure 3. Hemolytic activity of SeNPs. PEG and Triton-X were respectively used as negative control and positive control.

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