Genotoxocity of silver and selenium nanoparticles on human epithelial cells

Emerik Galić[a], Krunoslav Ilić[b], Mirta Milić[b], Sonja Hartl[c], Carolin Tetyczka[c], Tomislav Vinković[a], Eva Roblegg[c], Ivana Vinković Vrček[b], Ivan Pavičić[b]

a: University J.J. Strossmayer, Faculty of Agrobiotechnical Sciences, Osijek, Croatia
b: Institute for Medical Research and Occupational Health, Zagreb, Croatia
c: University of Graz, Institute of Pharmaceutical Sciences, Department of Pharmaceutical Technology and Biopharmacy, Graz, Austria

INTRODUCTION

Silver nanoparticles (AgNPs) are among the most commercialized engineered nanoparticles (NPs) due to their excellent biocidal properties [1]. Selenium nanoparticles (SeNPs) represent promising new candidates for biomedicine due to their antioxidat activity, biodegradability and biocompatibility [2]. There is a plethora of *in vitro* studies on cellular effects of different types of AgNPs, while data on SeNPs are still scarce. This study aimed to investigate genotoxic effects of different AgNPs and SeNPs on to distinct types of human epithelial cells. For this purpose, AgNPs and SeNPs were prepared in the presence of two polymers: neutral polyvinylpyrrolidone (PVP) and positively charged poly-L-lysine (PLL); as stabilizing agents. The produced NPs were carefully characterized using light scattering technique and transmission electron microscopy. Genotoxic effects were determined in vitro on human keratinocytes (HaCaT) and human buccal epithelial cells (TR146) by the alkaline Comet assay.

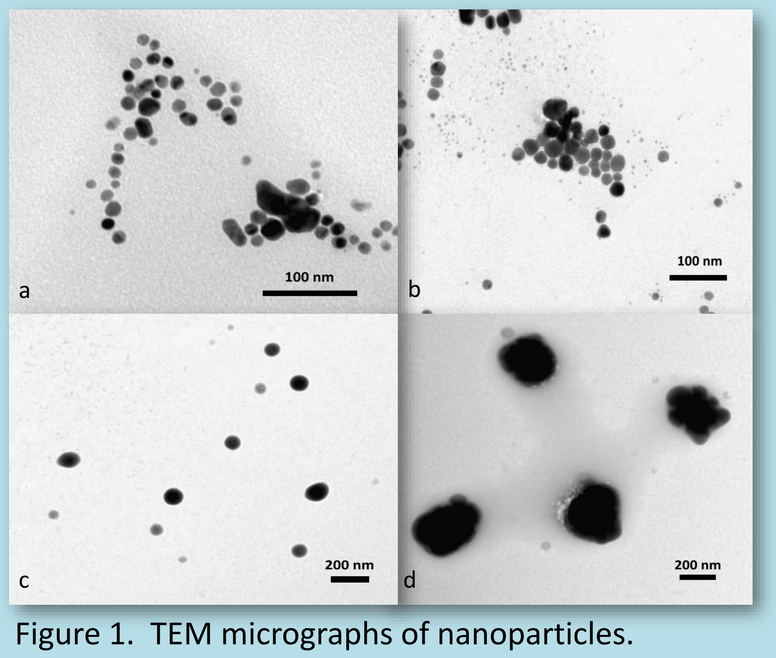

Figure 1. TEM micrographs of nanoparticles.
(a: PVP-AgNP; b:PLL-AgNP; c: PVP-SeNP; d: PLL-SeNPs)

RESULTS

The AgNPs and SeNPs showed a size of 10 nm and 50 nm, respectively, were spherically shaped and colloidal stable in water. The Comet assay examined that AgNPs induced DNA damage at different concentrations. Significant DNA damages on TR146 cells were observed at 10 ppm or higher for AgPVP; at 0.5 ppm and higher for AgPLL. AgNPs showed no genotoxic effects on HaCaT cells. Both types of SeNP increased the tail intensity values compared to control in TR146 and HaCaT cells at much lower concentrations compared to AgNPs. Highest effect was observed for PLLSe, which show significant effect at concentrations of 0,5 ppm on buccal buccal epithelium and 5 ppm for human keratinocytes.

Table 1. Hidrodinamic diameter and zeta potential values in ultra-pure water (UPW) mesured using DLS and ELS methods

	Dh /nm (% volume)	Z / mV
AgPVP	77.5 ± 13.2 (34%) 636.1 ± 94.4 (66%)	-16.7 ± 0.1
AgPLL	23.2 ± 4.8 (23%) 111.1 ± 8.7 (77%)	37.5 ± 0.4
SePVP	118.7 ± 13.4 (100%)	-30.1 ± 0.3
SePLL	107.5 ± 0.6 (58%)	24.9 ± 0.3

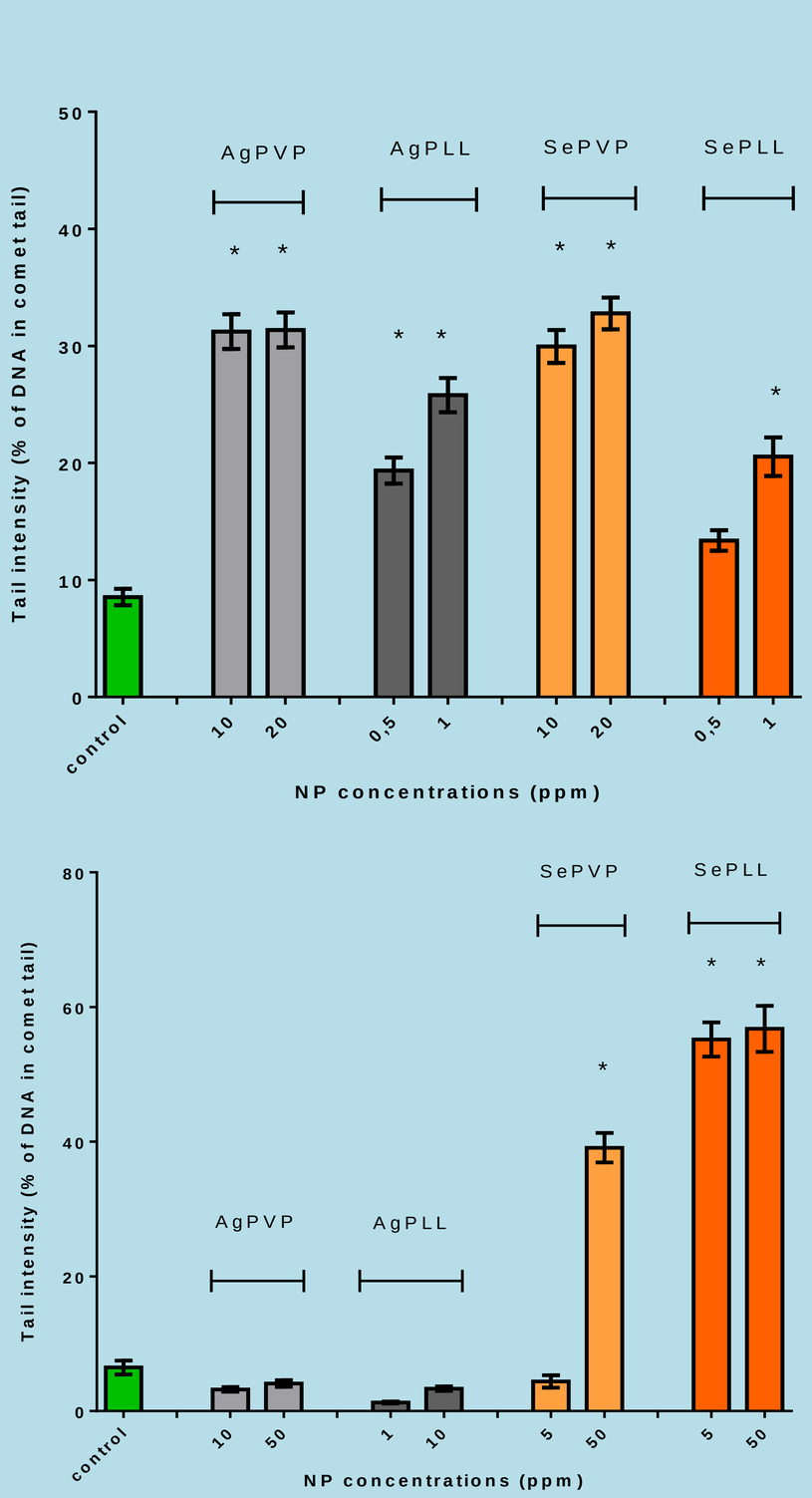

Figure 2. DNA damage induced by AgNPs and SeNPs on TR146 human buccal cells (upper panel) and HaCaT human keratinocytes (lower panel). Error bars represent standard error. Asterisks (*) indicate significant differences compared to control (untreated cells) at $P < 0.05$.

CONCLUSION

We investigated genetoxic effects of different types of silver and selenium nanoparticles in two cell lines. It was shown that both AgNPs and SeNPs cause significant damage in TR146 cells. HaCaT cells seem to be more resilient to AgNPs, altough show high sensitivity when treated with SeNPs. AgNPs and SeNPs coated with positively charged PLL have show genotoxic effect at lower concentrations than those coated with neutral PVP.

REFERENCES

[1] Reidy B., Haase A., Luch A., Dawson K. A. and Lynch I., Materials, **2013,** 6, 2295-2350.
[2] Vinković Vrček I., Selenium Nanoparticles: Biomedical Applications // Selenium / Michalke, Bernhard (Ed.). Berlin, Germany, Springer International Publishing, **2018**. pp 393-412.

IPTC 2019 - 12th International Particle Toxicology Conference
11-13 September 2019,
Salzburg, Austria

ACKNOWLEDGEMENT
This study was financially supported by the HRZZ-IP-2016-06-2436 and HRZZ-IP-2018-01-8119 grants.