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Interactions of ingested tungsten (WO_x) nanofibers with a model digestive gland tissue studied by SEM/EDS and FTIR

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Tungsten nanofibers, whiskers or needles are recognised as biologically reactive [1]. We study deviations in molecular composition between normal digestive gland tissue and digestive gland tissue of WO_x nanofibers (nano-WO_x) fed test organism *Porcellio scaber* with synchrotron based Fourier transform infrared (FTIR) spectroscopy. The FTIR analyses were supplemented by toxicity and cytotoxicity analyses. We also study interaction of ingested tungsten nanofibers with epithelial cells of digestive tube of test animals by scanning electron microscopy (SEM) and by energy dispersive x-ray spectroscopy (EDS).

The differences in the FTIR spectra of the WO_x-treated and control cells showed up in the central region of the digestive cells and are related to a changed protein to lipid ratio, lipid peroxidation and structural changes of nucleic acids. The conventional toxicity parameters failed to show toxic effects of nano-WO_x. Cytotoxicity biomarkers indicate sporadic effects of WO_x nanofibers. Scanning electron microscopy revealed that when the nanofibers entered the digestive system in some areas they react physically with epithelial cells of digestive tube leading to trusting of nanofibres into the cells (Figure 1). Energy dispersive x-ray spectroscopy confirmed presence of tungsten in cells trusted fiber-like structures (Figure 2).

The FTIR results obtained in our study are in agreement with toxicological and cytological measurements, which indicate that ingestion of nano-WO_x does not affect severely the cell membrane stability and feeding behaviour. However, nanofibers can cause injuries on the epithelial cells of digestive gland tube. Scanning electron microscopy results suggest that physical forces of peristaltic may have important role in nanofiber digestive/intestinal cell interactions what could not be predicted *in vitro*.

1. P. Leanderson and W. Sahle. Formation of Hydroxyl Radicals and Toxicity of Tungsten-Oxide Fibers. *Toxicol in Vitro* 1995, 9(2):175-183.

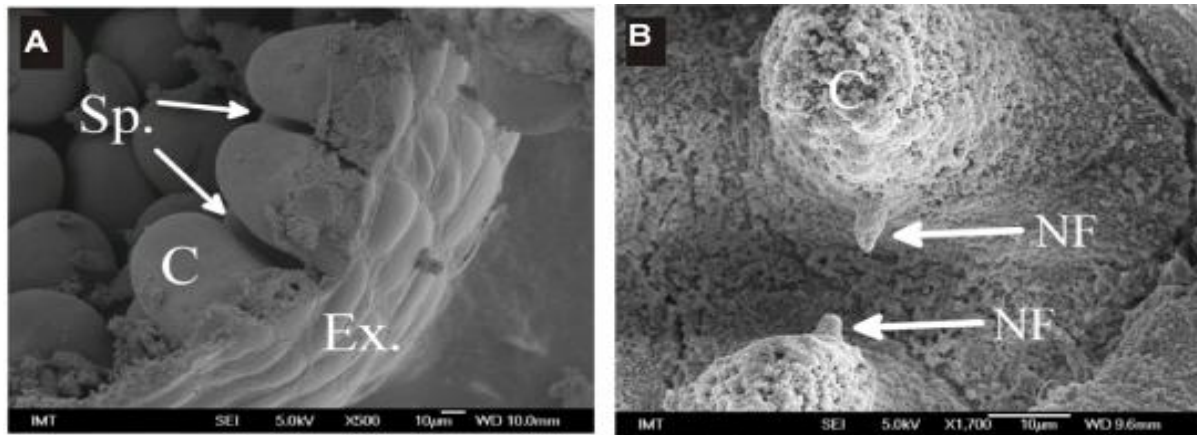


Figure 1. a) Part of digestive gland of control animal where spaces (Sp.) between cells are shown. (Ex. -external part of gland). b) Digestive gland cells (c) with trusted tungsten nanofibers (NF).

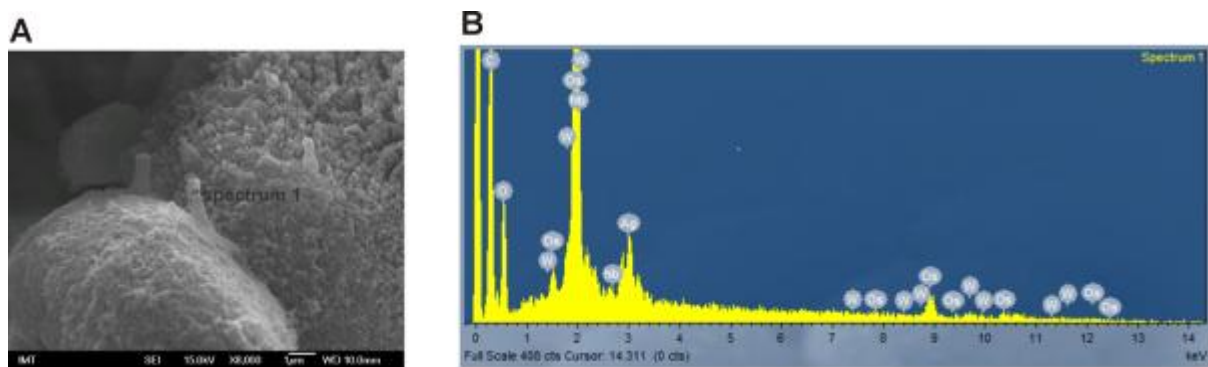


Figure 2. a) digestive gland cell with trusted nanofibers where EDS spectra was taken. b) EDS spectra confirming presence of tungsten in nanofiber trusted in the cell (spectrum 1 in figure A).