The cytotoxic antimicrobial effect of metallic nanoparticles leached from food packaging on an in vitro model of the human gastrointestinal tract, including probiotic microflora

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Metallic nanoparticles are known to induce toxic responses *in*-vitro. Despite this, nanomaterials are being used in the food industry and are relatively unregulated due to difficulties with detection, characterisation, dosing and effects with respect to the GI-tract. This study looks at nano – zinc oxide and nano-silver, both known to display antimicrobial effects, leading to their application in food contact materials (FCM) and direct additives in food and food supplements. This study will present evidence which suggests that leached nanoparticles from the composites could induce a toxic response *in-vitro* and affect the resident probiotic intestinal micro organisms. *In vitro* cytotoxicity studies were performed on two mammalian cell lines: AGS (ATTC No: CRL-1739) a stomach cell line, and SW480 (ATCC No: CCL-228) a colorectal cell line. Cellular viability, stress and geno-toxicity were assessed using cytological colorimetric assays, clonogenic studies, ROS monitoring and cytogenetic techniques. Results show that both nanomaterials induced a cytotoxic response that was both time, dose and cell line dependent. The toxicity was also seen to be mediated by bio- surfactants found naturally in the GI tract. Microbiological exposures were performed on two test species *Bifidobacterium breve UCC2003*, *Lactobacillus paracasei* both gram positive gut bacteria extracted from human samples, and a control species *Staphylococcus aureus* ATCC 25923 (gram positive). The antimicrobial activity of the nanoparticle suspensions was monitored by optical density analysis at various doses and exposure times. Only a slight adverse effect was observed in the activity of the small intestine inhabitant, *L. paracasei*, where as significant antimicrobial activity was observed in the control species pathogenic species *S. aureus*. The large intestinal probiotic *B. breve* was the most sensitive to the antimicrobial effects of nano ZnO and nano - Ag, with relatively low exposure concentrations resulting in almost 100% inhibition of growth. The implications of the work will be discussed in terms of the use nano-enabled technologies in the food sector.