Topical absorption and safety of nanomaterials applied to human skin

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The talk describes our journey of assessing the safety of topically applied nanoparticles. A particular focus is on those applied to the skin for cosmetic, consumer protection and therapeutic purposes. This work has involved the assessment of nanoparticle exposure and hazard using various techniques, including electron microscopy, multiphoton fluorescence lifetime imaging microscopy, laser ablation inductively coupled plasma mass spectrometry and synchrotron X-ray fluorescence microscopy in both the x,y and x,z planes in both *ex vivo* and *in vivo* human skin. Our studies have focused on the absorption, disposition and effects of nano zinc oxide, zinc pyrithione, nano silver, zinc ions and quantum dots in human epidermal cells, in animals, in excised human skin, in volunteers and in psoriatic patients.

Our key findings are that, whilst all nanoparticles have the potential to be toxic, especially in cell cultures, the larger nanoparticles now used in consumer products are safe because they are intrinsically not hazardous in the formulations used and are rarely absorbed intact after application to human skin. These findings apply for a range of application conditions, including occlusion, massage, flexing, repeated exposure and different skin types. However, zinc ions released after the application of nano zinc oxide and zinc pyrithione to the skin are absorbed into the viable epidermis and can enter into the systemic blood and excreted into the urine. However, this systemic exposure is less than the normal levels of zinc ions found in the body arising from the ingestion of food from various sources.

The importance of our work is that it shows that various nanoparticles can be safely used in a number of consumer products to meet various needs and that the products may assist in minimizing adverse sequelae such as actinic keratosis, skin cancer and other conditions that may arise when they are not used.

References

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