

NanoTiO₂ Sunscreens Skin Qbsorption and Questionable Effect to Prevent UV Radiation Damage

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OBJECTIVE: We tested skin absorption and toxicity of nanoparticles from nanoTiO₂ sunscreen in humans, as nanoTiO₂ in experimental studies perturbed stratum corneum and generated reactive oxygen species. The second aim was to verify sunscreens efficiency to prevent oxidative stress/inflammation caused by the ultraviolet (UV) radiation using biomarkers in volunteers' blood, urine, and exhaled breath condensate (EBC).

METHODS: Six identical volunteers participated in three tests: (A) nanoTiO₂ commercial sunscreen, (B) UV radiation, and (C) sunscreen+UV. First samples were collected on day 1 before the test and second after sunscreen application and/or UV exposure. On day 4, third samples were collected, and the sunscreen was washed off; fourth samples were collected on day 11. Titania was measured using inductively coupled plasma mass spectrometry and TiO₂ nano particles by transmission and scanning electron microscopy. The biomarkers malondialdehyde, 4-hydroxy-trans-hexenal, 4-hydroxy-trans-nonanal, aldehydes C6-C12, 8-isoProstaglandin F₂α, o-tyrosine, 3-chlorotyrosine, 3-nitrotyrosine, 8-hydroxy-2-deoxyguanosine, 8-hydroxyguanosine, 5-hydroxymethyl uracil, and leukotrienes, were measured using liquid chromatography-electrospray ionization-tandem mass spectrometry.

RESULTS: Titania and nanoTiO₂ particles were found only in the plasma (9.3±3.1 ng/mL) and urine (6.7±1.7 ng/mL) samples 2-4 in the women and samples 3-4 in men in test A and C. Sunscreen alone did not prove toxic effect. UV increased all biomarkers in samples 2 (p<0.05). The sunscreen prevented skin redness; but did not inhibit the elevation of biomarkers caused by UV radiation.

CONCLUSIONS: NanoTiO₂ particles can pass through the protective layers of the skin both with and without UV irradiation into systemic circulation as measurable titania levels and TiO₂ nanoparticles were found in plasma and urine. Negative findings in the EBC exclude inhalational contamination. NanoTiO₂ itself did not show toxicity measured by markers of oxidative stress/inflammation but did not prevent their elevation due to UV. Therefore, efficacy of the sunscreen to prevent skin cancers may be questioned