In vivo Confocal Raman Spectroscopy and Biochemical Interactions of Hazardous Pollutants in Human Skin

A A Martin[1,2*], P P Fávero[1,2] and G Carlos[1,2]
[1]Universidade Brasil, São Paulo, Brasil
[2]DermoProbes, São José dos Campos, Brasil
*Airton.a.martin@gmail.com

Background. The human skin is continuously exposed to environmental air pollutants such as, particulate matter (PM), sulfur dioxide (SO_2), smoke, carbon monoxide (CO), ozone (O_3) and nitrogen dioxide (NO_2), polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs). The possibility of these pollutants permeate on human skin has been associated with molecular processes that damage its structure, leading to skin aging through inflammatory process, skin dryness, loss of firmness, dark spots, uneven skin tone, fine lines and wrinkles. In addition, pollution is related to allergic skin conditions such as: atopic dermatitis, eczema, psoriasis or acne. Skin cancer is among the most serious effects (Figure 1). Anti-pollution cosmetics have become quite the trend over the last year, to developing active ingredients to tackle these pollutants. The present work aims to determine the applications of the Confocal Raman spectroscopy in analysing the extent of penetration /permeation of certain hazardous pollutants in human skin and to understand the main interactions with these biological components.

Methods. Ten human skin sections obtained through surgery were treated with individual pollutants for four days. Together with the skin samples, the pollutant solution and the anti-pollution formulation were also analysed through Raman. For the purpose of analysis, a drop of the test solution was placed on the window and spectra were acquired. The experimental study involves the measurement of dermal uptake kinetics of a solution of a pollutant in three different conditions, a skin with no previous treatment, a skin with a placebo and a skin with the product to avoid the pollutant penetration. Raman spectra were acquired by confocal Raman Spectrometer (River Diagnostics®, Model 3510- Netherlands) installed at DermoProbes with 785 nm diode laser. The spectra were collected as a function of 0-60 μm depth. For Raman spectra analysis, the spectral data were baseline corrected and vector normalized before the determination of peak heights and area. Spectral data (average spectra) were analysed through Origin Pro 8.5 software. Here, the spectra obtained from different layers of the skin sections were correlated with the spectral peaks of the test solution. The permeation profile were calculated and plotted.

Results. It can be verified that the pollutant is present in all skin layers measured from 0 μm to 60 μm depth.

Discussion and Conclusions. According to the preliminary results, it shows that the pollutant permeation can reach 60 μm in a treated skin and an untreated one. However, the product reduced the amount of pollutant up to 80% if compared to the two others groups.

Figure 1: Pollution effect on human skin
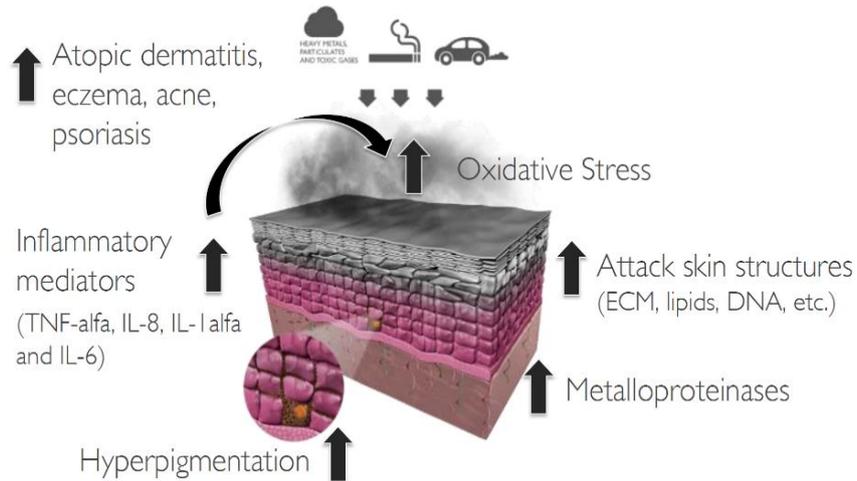
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