Skin model of pollutants penetration helps demonstrate the protective activity of a natural water

Poster ID 354

Cenizo Valérie[1]; Lemaire Géraldine[1] ; Olivero Malvina[1] ; Rouquet Virginie[1] ; Decombe Clément[2] ; Robin Sophie[2] ; Portes Pascal[1]*
1 L'Occitane en Provence - L'Occitane Group, Manosque, France
2 Biotoskin, Besançon, France ; 3 Bioexigence, Besançon, France

Introduction

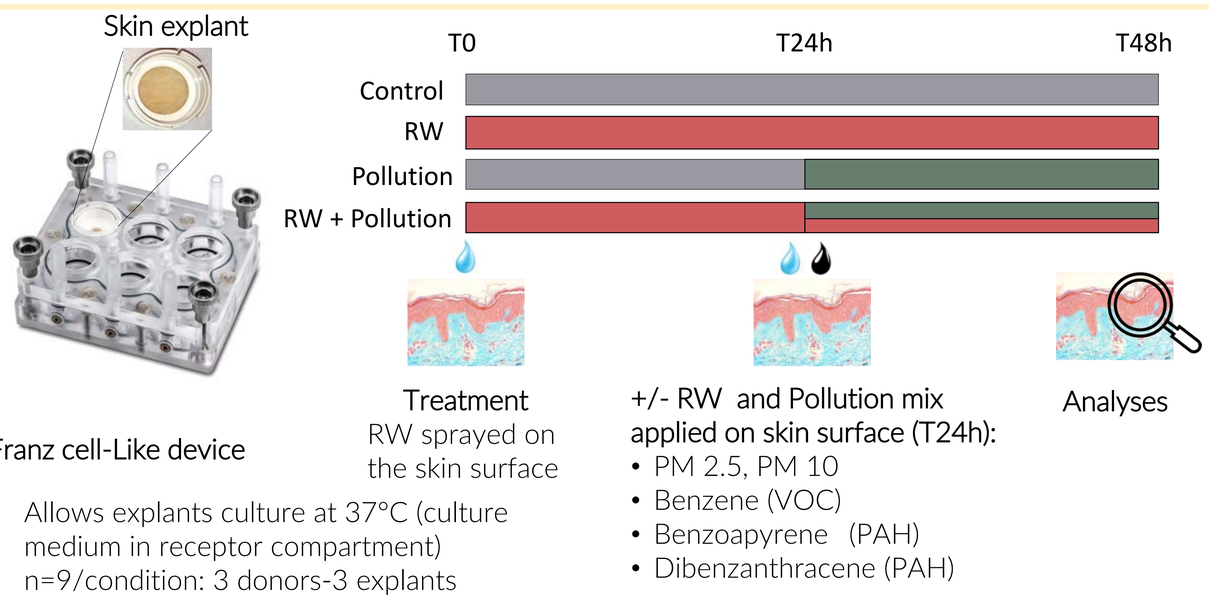
The exposition of skin to air pollutants has been associated with skin cancer, inflammatory and allergic skin conditions [1], premature skin aging and particularly pigment spot formation [2]. Pollutants are composed of a heterogeneous mixture of suspended gases, liquids and solids and are classified according to their physicochemical properties [3]: particulate matter (PM), and gazes. Gazes are represented for example by ozone (O3), carbon monoxide (CO) and volatile organic compounds (VOCs). PM is classified by diameter, coarse (PM10 2,5-10 µm), fine (PM2.5 <2,5 µm) and ultrafine (< 0,1 µm) and composed of a mixture of organic compounds such as polycyclic aromatic hydrocarbons (PAHs) and inorganic compounds such as heavy metals bound to it.

The skin permeability barrier prevents penetration of chemicals from the environment, but large amounts of airborne pollutants can overwhelm it and even alter it. Calcium plays a pivotal role in the formation of this barrier function by inducing keratinocytes differentiation, adherent junctions proper functioning and the deposition of tight junctions' protein components to the cell membrane via the calcium-sensing receptor (CaSR) activation [4].

Réotier water (RW) is a calcium-rich natural water from the French Alps, which has been used since ancient times to cure and soothe the skin conditions. We previously demonstrated that Réotier water (RW) reinforces the permeability barrier [5].

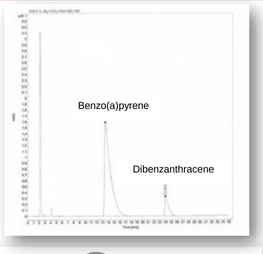
The goal of this study was to test whether RW was able to prevent pollutants penetration and therefore limit their deleterious effect, we setup a pollutants penetration assay using a living skin model in culture.

Materials & Methods:

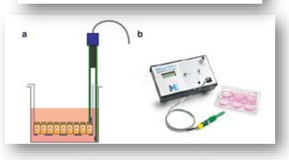


- Allows explants culture at 37°C (culture medium in receptor compartment)
- n=9/condition: 3 donors-3 explants

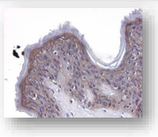
Analyses 24 hours after exposure to pollutants



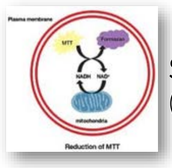
Pollutants quantification (HPLC, GC-MS, ICP-MS) in skin compartments (24h) and receptor medium (kinetics)



Skin barrier
Transepithelial electrical resistance (TEER)



Tight junctions
claudin 1 immunostaining

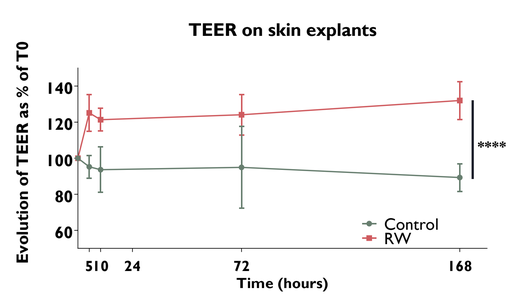


Skin viability
(MTT)

Transcriptomics
(DNA array)

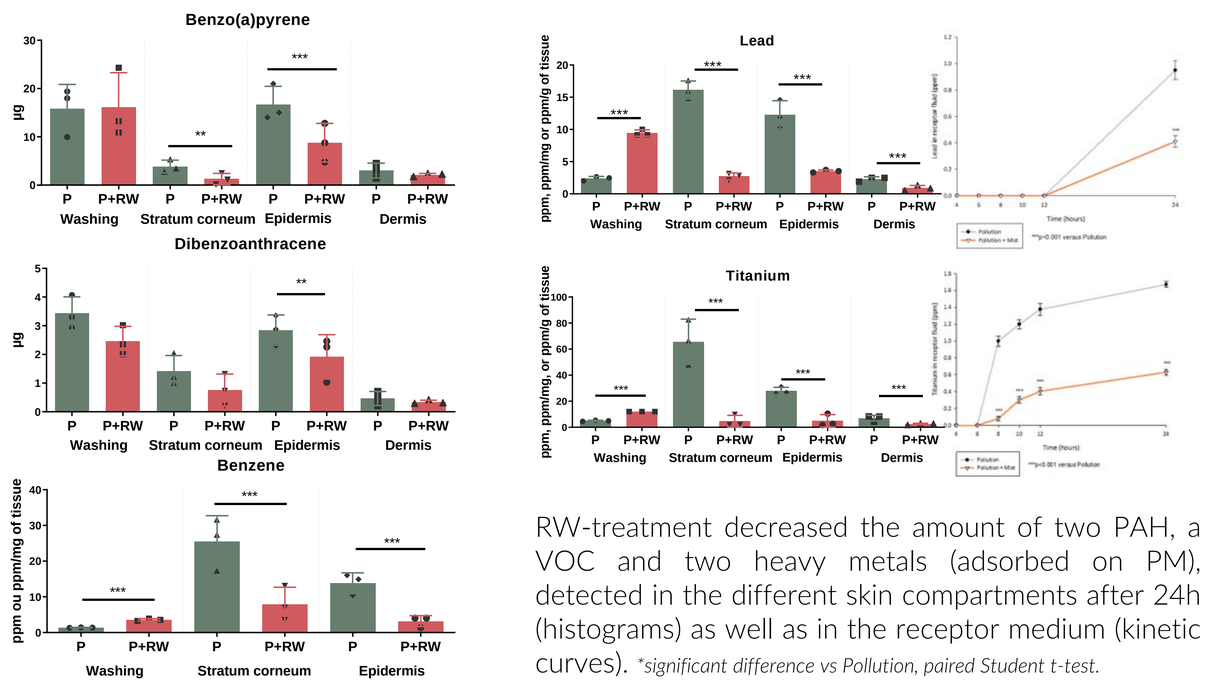
Results & Discussion:

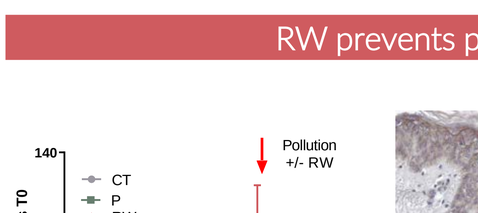
RW rapidly reinforces the skin barrier function



In a preliminary experiment, RW was sprayed daily on the surface of skin explants placed in the D-Skin cell device allowing explants culture. As expected, RW increased TEER after 3 and 7 days in culture (+47%) but more surprisingly, also as soon as 5 hours after the first treatment (+31%) suggesting that RW could rapidly prevent small molecules penetration.

RW limits pollutants penetration



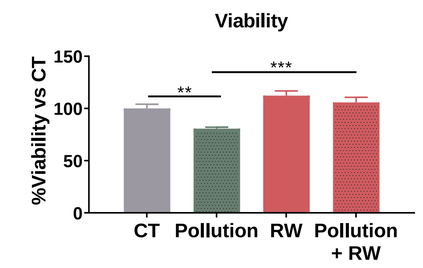


RW-treatment decreased the amount of two PAH, a VOC and two heavy metals (adsorbed on PM), detected in the different skin compartments after 24h (histograms) as well as in the receptor medium (kinetic curves). **significant difference vs Pollution, paired Student t-test.*

RW prevents pollution-induced barrier disruption

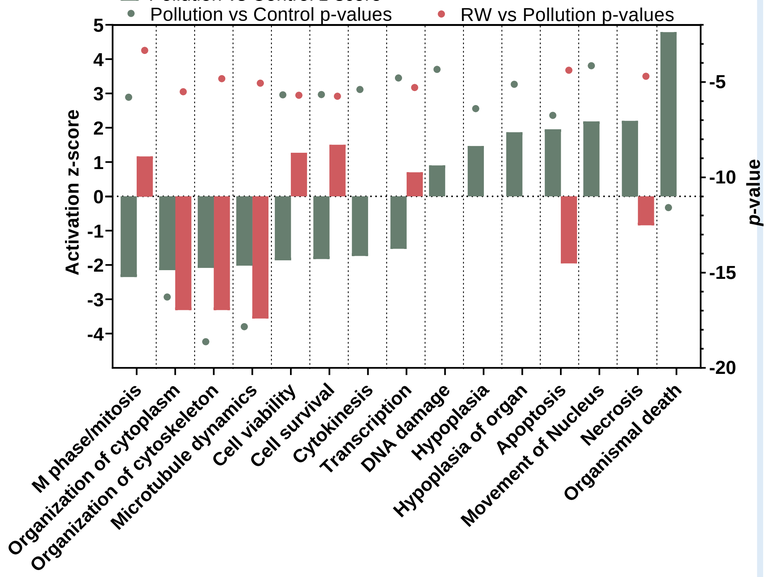
RW-pretreatment prevented pollution-induced TEER drop. Barrier integrity maintenance could not be explained by TJ proteins synthesis as claudin-1 level is unchanged, but could rather be due to rapid TJ proteins translocation at the cell membrane upon calcium receptor activation [4],

RW protects skin from pollution-induced cytotoxicity



RW prevented pollution-induced cytotoxicity.

Gene pathways related to functions such as **necrosis, apoptosis were decreased** in RW-pretreated samples compared to pollution-exposed samples while functions linked to **transcription, cell viability and cell cycle (mitosis) were increased**



References:

[1] Drakaki E et al. (2014) Air pollution and the skin. Front. Environ. Sci., vol. 2. 15 May
[2] Vierkötter A et al. (2010) Airborne particle exposure and extrinsic skin aging. J Invest Dermatol ;130:2719–26.
[3] Sompornrattanaphan M. et al. (2020) The contribution of particulate matter to respiratory allergy. Asian Pac J Allergy Immunol. Mar;38(1):19-28
[4] Jouret F et al. (2013) Activation of the Ca2+-sensing receptor induces deposition of tight junction components to the epithelial cell plasma membrane. J Cell Sci. Nov 15;126 (Pt 22) :5132-42.
[5] Cenizo V et al. (2018) Instant and long-term skin barrier strenghthening help reduce skin discomfort and increase skin hydration. IFSCC congress. Full paper 344

Conclusions:

This model of pollutants penetration on a living skin in culture allowed to demonstrate that Réotier water can enhance the skin permeability barrier in just a few hours and limit pollutants penetration and their toxicity on skin.