

THE FRENCH VELAY GREEN CLAY ATTENUATES ENVIRONMENTAL POLLUTANT-INDUCED DAMAGES IN A 3D FULL-THICKNESS SKIN EQUIVALENT MODEL

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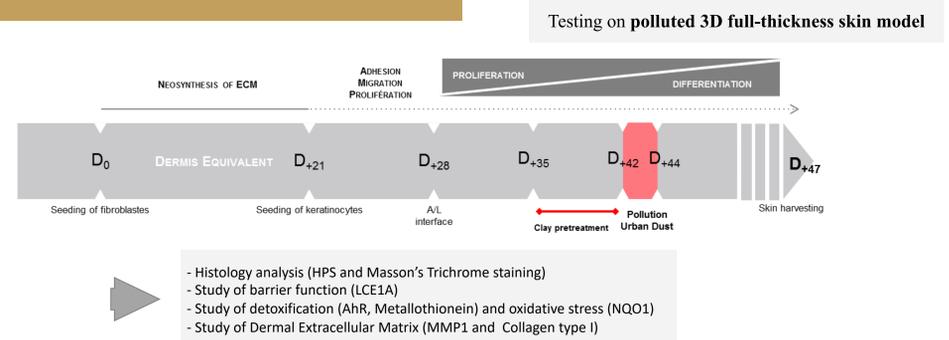


Introduction

Since ancient time, natural clays have been important resources for human and animal health care because of their therapeutic and curative properties. Skin topical clays' application was observed to be effective in reducing skin lesions, in healing infected tissues and at improving overall skin conditions. The healing effects of these clays have been attributed to their mineral and chemical compositions and ion exchange, antibacterial, and adsorptive properties.

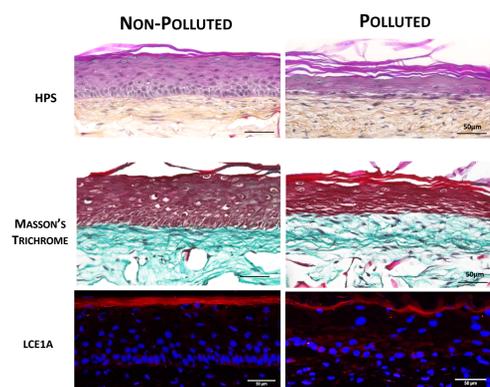
To further investigate the effects of clays on the skin, we examined for the first time the influence of the Velay green clay, extracted at the feet of the Auvergne volcanoes in France, on pollution-induced damage using a 3D full-thickness skin model. In this study, the Velay green clay has been chosen due to its unique mineralogical composition, a natural blend of 3 different clays, and also for its purity.

Materials & Methods

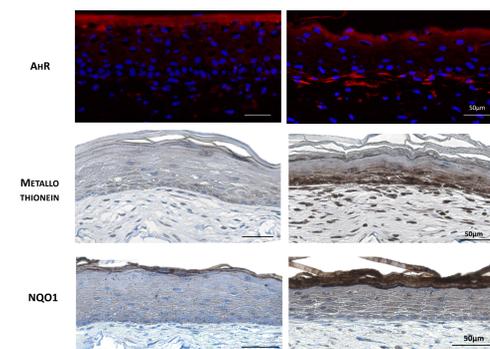


Results & Discussion

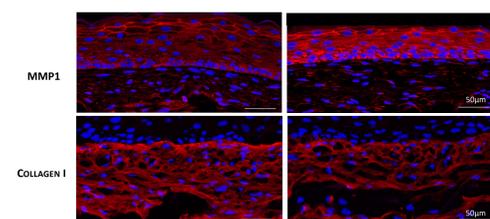
Validation of the polluted 3D skin model



Thinner epidermis, thicker stratum corneum, perturbation of the barrier function



Signs of toxicity and oxidative stress

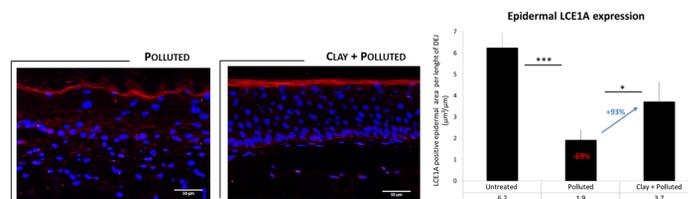


Type I collagen decrease correlated with an increase of MMP-1

Effects of the Velay Green Clay on pollution

Reinforcement of the barrier function

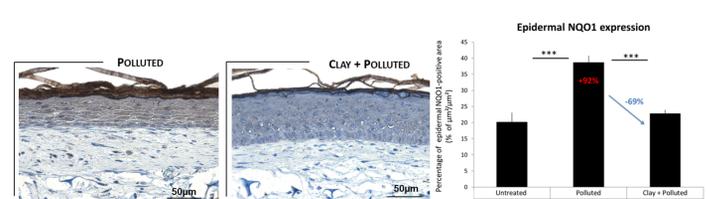
LCE1A protein (Late Cornified Envelope 1A) in the *stratum corneum* participates to the cutaneous barrier function



Pollution decreased LCE1A expression by 69% compared to the unpolluted condition. The Velay Green Clay treatment increased LCE1A expression in the stratum corneum by 93% compared to the polluted condition.

Protection against oxidative stress

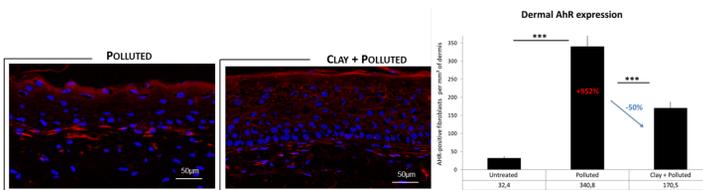
NQO1 (NAD(P)H dehydrogenase [quinone]1) enzyme fights against free radicals setting up and playing a detoxifying role in the oxidative stress context



Pollution increased epidermal NQO1 expression by 92% compared to the unpolluted condition. The Velay Green Clay treatment decreased NQO1 expression by 69% compared to the polluted condition.

Protection against toxicity

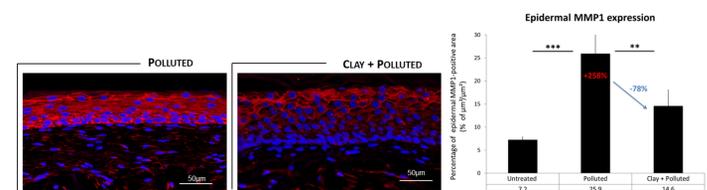
AhR protein (Aryhydrocarbon Receptor) is a receptor regulating the response to cellular toxicity



Pollution increased dermal AhR expression by 952% compared to the unpolluted condition. The Velay Green Clay treatment decreased AhR expression by 50% compared to the polluted condition

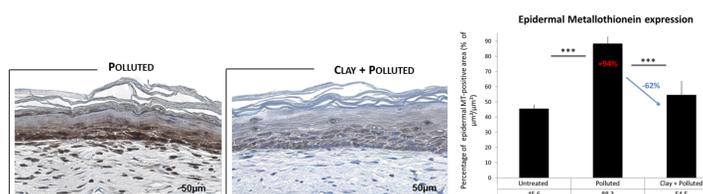
Reinforcement of the dermal extracellular matrix

MMP1 enzyme (Matrix metalloproteinase-1), member of collagenase family, is able to degrade type I and III collagens



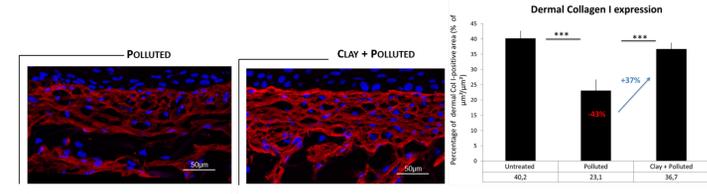
Pollution increased dermal MMP1 expression by 258% compared to the unpolluted condition. The Velay Green Clay treatment decreased MMP1 expression by 78% compared to the polluted condition

Metallothionein protein has an affinity for metal ions contributing to the cellular detoxification



Pollution increased epidermal Metallothionein expression by 94% compared to the unpolluted condition. The Velay Green Clay treatment decreased Metallothionein expression by 62% compared to the polluted condition

Type I collagen protein is the major component of the dermal extracellular matrix



Pollution decreased Collagen I expression by 43% compared to the unpolluted condition. The Velay Green Clay treatment increased Collagen expression by 37% compared to the polluted condition

Conclusions

Our results demonstrated a significant impact of the urban-dust pollution on our 3D skin model compared with the non-polluted condition. At the epidermal level, we demonstrated a perturbation of the barrier function as observed *in vivo*. At the dermal level, we observed a significant type I collagen expression decrease, correlated with a strong MMP-1 expression increase. At the global level, we observed strong signs of toxicity and oxidative stress.

The Velay green clay preventive treatment significantly attenuated the damages induced by pollution in our 3D skin model. Our results showed a significant stimulation of the LCE1A demonstrating the reinforcement of the epidermal barrier function. Type I collagen expression was also increased compared with the untreated/polluted control, demonstrating the reinforcement of the dermal extracellular matrix, in good correlation with the significant decrease of MMP-1 expression. We also observed a significant decrease of arylhydrocarbon receptor, metallothionein and NAD(P)H quinone dehydrogenase 1 showing the protective effects of the Velay green clay against the toxicity and oxidative stress induced by pollutants.

Overall, these results demonstrate the French Velay green clay protective effects against environmental damages caused by the urban-dust pollution on a 3D skin model and put in emphasis the importance of its use in skin therapies.

References

- López-Galindo, A.; Viseras, C.; Cerezo, P. Compositional, technical and safety specifications of clays to be used as pharmaceutical and cosmetic products. *Appl. Clay Sci.* 2007, 36, 51–63.
- Carretero, M.I. Clay and non-clay minerals in the pharmaceutical and cosmetic industries Part II. Active ingredients. *Appl. Clay Sci.* 2010, 47, 171–181.
- Dijkhoff, I. M. Impact of airborne particulate matter on skin: a systematic review from epidemiology to *in vitro* studies. *Particle and fibre toxicology*, 2020, vol. 17, no 1, p. 1–28.
- Williams, L. B. Chemical and mineralogical characteristics of French green clays used for healing. *Clays and Clay Minerals*, 2008, vol. 56, no 4, p. 437–452.