A confined environment triggers prolonged contact with indoor pollutants. An upcycled lavender-derived product to the rescue.

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INTRODUCTION

According to the latest World Health Organization (WHO) report, ambient air pollution was responsible for more than four million deaths per year[1]. Volatile and semi-volatile organic chemicals are widely used as ingredients in household products (paints, varnishes, waxes...). Due to the structurally more confined nature of the indoor environment, concentrations of many volatile organic compounds and polyaromatic hydrocarbons (PAHs) are consistently higher indoors (up to five times higher) than outdoors[2].

Skin is the largest and outermost organ of the human body, which makes it an important barrier against aggression from the environment. However, there is evidence that some pollutants were able to impact keratinocyte physiology[3] either by crossing the barrier or via systemic circulation after inhalation. Following penetration, pollutants may induce xenobiotic metabolizing enzymes, through activation of the Aryl Hydrocarbon Receptor (AhR) pathway[4]. By triggering xenobiotic metabolism, pollutants may activate cascades that are deleterious to skin cells, such as oxidative stress, nucleic acid damage, inflammation, and impairment of skin barrier function[5].

Lavandula angustifolia Mill. (Lamiaceae) is well known as a powerful aromatic and medicinal herb. After volatile extraction, the spent material rich in flavonoids and phenolic acids can then be upcycled to produce a cosmetic active ingredient. The aim of the present study was to demonstrate the benefits of an upcycled lavender extract in protecting sensitive skin against organic volatile pollutants, strengthening the barrier function and decreasing irritation.

MATERIALS & METHODS

The cosmetic active ingredient under study is an extract of the aerial parts of lavender *(Lavandula angustifolia* Mill.), a by-product from the fragrance industry, obtained using a proprietary water-based process. The ingredient is COSMOS approved and standardized for rosmarinic acid content to ensure batch-to-batch consistency, quality and biological efficacy. The upcycled lavender extract is stabilized with non-palm certified glycerin.

***In vitro* studies:** Evaluation of antioxidant and anti-inflammatory activity of the lavender extract on normal human dermal fibroblasts (NHDF) after stimulation of ROS production with pyocyanin and IL8 production with IL1-α. Keratinocyte differentiation has been assessed after 48H of stimulation with or without lavender extract, by looking at keratin10 gene expression.

***In vivo* studies:**

- On 11 volunteers with sensitive skin: evaluation of the trans-epidermal water loss (TEWL) after 14 days of lavender extract application at 1% in a simple gel formula, vs placebo.
- Indoor pollutant exposure on 16 volunteers with sensitive skin: Application on the forearm of indoor (house-dust NIST2585) pollutants thanks to the Controlled Pollution Exposure System for 2H for 4 days. Application of the Lavender extract at 1% twice a day, 14 days before pollutant application, and during the application. Evaluation of inflammatory activity by measurement of IL1a directly on volunteer skin by swabbing and assessment of the skin luminosity by chromameter, vs placebo.

RESULTS

In vitro evaluation on human fibroblast cultures (NHDF)

Polycyclic Aryl Hydrocarbons, as ligands of the AhR, induce the transcription of xenobiotic metabolism, especially cytochromes P450 that can generate reactive oxygen species during their cycle of reaction[6]. This oxidative stress triggers the inflammatory cascade.

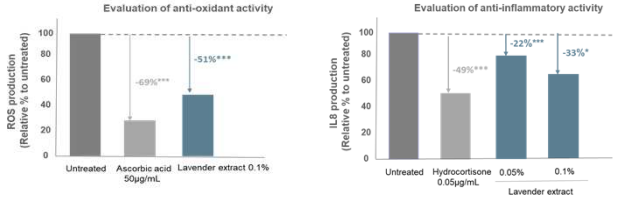
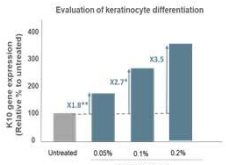


FIG.1: Inhibition of Reactive Oxygen Species (ROS) and IL8 production by the upcycled lavender extract in dermal fibroblast cultures

These results highlight the capacity of the upcycled lavender extract to protect the dermis against oxidative stress and to inhibit the early steps of the inflammatory cascade in the skin. Similar results have been observed on keratinocytes, thus protecting also the epidermis layer.

RESULTS

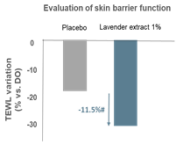
In vitro evaluation on human keratinocytes (NHEK)



After 48h of treatment, the upcycled lavender extract triggers a clear, significant and dose-dependent enhancement of Keratin 10 gene expression (up to 3.5 times), indicating an improvement of keratinocyte differentiation under lavender treatment, and therefore an enhancement of the natural barrier function and skin cohesion.

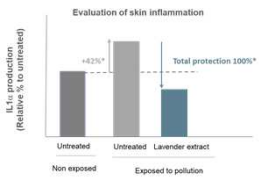
FIG.2: Increase of the Keratin 10 gene expression by the upcycled lavender extract in human keratinocyte cultures

In vivo



After 14 days, TEWL significantly decreased by 29% compared to D0, showing a strengthening of the skin barrier function. 82% of the volunteers showed better skin barrier function after application of the upcycled lavender extract at 1% for 14 days.

FIG.3: Decrease of the trans-epidermal water loss on 11 volunteers after application of the upcycled lavender extract at 1% for 14 days



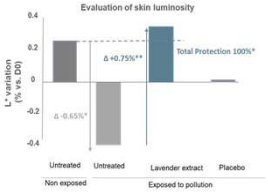


FIG.4: Protection of skin inflammation and decreased skin luminosity after pollutant application by the upcycled lavender extract at 1%

As expected, we observed an increase of IL1-α skin level after exposure to pollutants (+42%*). Where the skin was treated with 1% of upcycled lavender extract, IL1-α production remained at a lower level, somewhat below that observed in an untreated, unexposed skin area - showing a 100% protective effect.

At D17, on volunteers who responded to pollutant exposure at the non-treated zone, we observed a decrease of the L* parameter. When treated with the upcycled lavender extract at 1%, the skin luminosity remained at its initial level for these volunteers, neutralizing the effects of pollution exposure.

DISCUSSION & CONCLUSIONS

While outdoor pollution consists mainly of heavy molecules like diesel particles, which interact with the surface of the skin, indoor pollution is mostly made up of more volatile and smaller compounds, penetrating deeper into skin layers. These pollutants have ability to impair skin barrier function by damaging tight junctions. This permeabilization can also give rise to an enhancement of oxidative and inflammatory cascades, triggering accelerated skin aging and dull complexion. A specific skin protection against this type of pollutants is required.

For the first time, thanks to the controlled pollution exposure system, we were able to explore, in a standardized way, the effect of indoor pollutants composed of PAHs and other organic volatile or semi-volatile compounds on an *in-vivo* model, increasing skin irritation and decreasing skin luminosity. By strengthening the barrier function and mitigating the oxidative and inflammatory cascades, the upcycled lavender extract protects sensitive skin by decreasing irritation and enhancing skin luminosity after indoor pollutant exposure.

Like the cosmetic industry, the perfume industry uses more and more natural resources for the development of fragrance ingredients. To recover the aromatic fraction, tons of plant are processed. The upcycled lavender extract comes from a by-product of this fragrance industry, with wide availability, without need to use more cultivated surface, and with the possibility to lessen the environmental burden of the primary product.

ACKNOWLEDGMENTS

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