PROTECTION FROM POLLUTANTS

Active ingredients | Alicia Giménez from Lipotec on how Pollushield* works against the effects of pollutants on the skin.

AUTHOR: Alicia Giménez, Product Specialist
Cristina Davi, Elena Cañadas, Laia González, Raquel Delgado, Lipotec, Gavà, Spain
Alicia.gimenez@lipotec.com
www.lipotec.com

There is increasing concern about the high level of environmental contamination all over the world, and people are increasingly aware of the deleterious effects of pollutants on the skin. In order to minimize these negative consequences, Pollushield functional ingredient has been developed. The application of this cosmetic ingredient can help prevent accumulation of particles in the epidermis and replenish the skin with antioxidants, increasing its capacity to resist the harm caused by pollutants.

Contaminants in the environment

Affecting most regions of the world, environmental pollution is an important and widespread concern and has detrimental effects on the air, water and land. Atmospheric pollution affects the outdoor air of many cities and is mainly due to fuel combustion for transportation, but it is also very present indoors, where it results from biomass burning for cooking or heating and tobacco smoking[1]. Water pollution frequently results from agricultural and industrial work. However, by-products of water purification procedures, such as chlorine or ozone, are sometimes found in drinking water[2].

Pollution consists of a complex mixture of chemicals. Among the most prominent pollutants is particulate matter (PM), formed by harmful micro-particles and liquid droplets that are classified according to their size (e.g. PM10 and PM2.5).

photo: Ollyy, Shutterstock.com

Toxic metals, such as cadmium, mercury, lead and nickel, can persist and accumulate in the environment. Volatile organic compounds and gaseous pollutants, such as nitrogen oxides for example, need to be considered as well.

How pollution damages the skin

Being the first line of defence against the environment, the skin is in direct contact with air and water contaminants.

These substances cause detrimental effects, including irritation or premature ageing. In cutaneous tissues, pollutants drive the production of free radicals that react with biological molecules leading to loss of function (e.g. lipid peroxidation)[3].

In addition, in the presence of toxic substances or when oxidative stress occurs, the skin responds in a certain way such as synthesising metallothioneins, proteins with metal-binding properties that play a role in detoxifying heavy metals and radicals[4]. Another response is the reduced density of epidermal Langerhans cells. These cells absorb

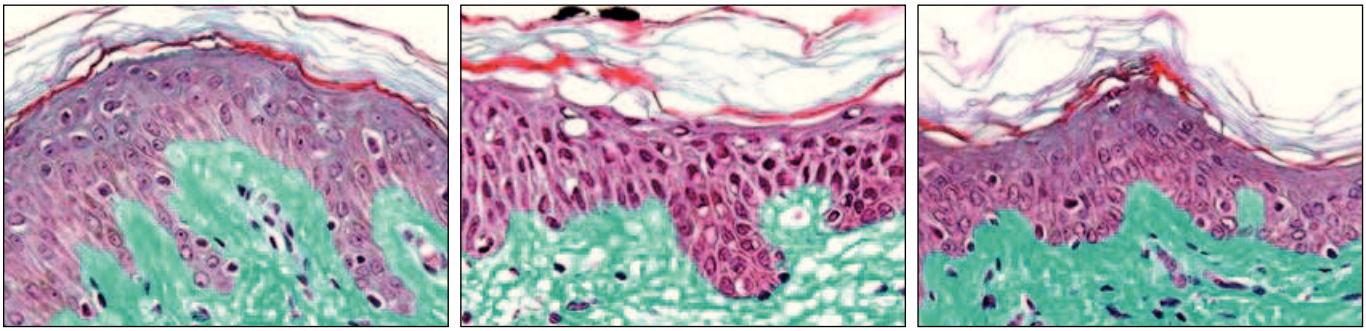

Fig. 1: The active ingredient helped preserve normal morphology in pollution-exposed skin (right) in contrast to non-treated non-exposed skin (left) and non-treated pollution-exposed skin (middle)

pollutants and then migrate away from the epidermis, presenting these substances to the immune system and subsequently initiating its defensive response. High pollution results in a lower number of Langerhans cells in the epidermis, which makes skin immunity decline[5].

Reducing the negative impact through cosmetics

The skin has a certain ability to defend itself from pollutants and their effects. Its physical barrier properties help minimize penetration of pollutants. Also, the skin has endogenous antioxidative defences consisting of vitamins and enzymes. However, when exposed to high levels of contaminants, the protecting capacity of the skin is surpassed, leading to visible consequences of damage and accelerated ageing[6].

"INGREDIENT BINDS TOXIC METALS AND WORKS AS AN ANTIOXIDANT"

Now that it is so difficult to avoid pollution, some shielding strategies can be adopted. By topically applying protective films or molecules such as metal chelators, it is possible to reduce the direct interaction of pollution particles with the skin. In addition, it is essential to provide antioxidants to complement the loss of endogenous ones due to overexposure to harmful substances or the ageing process. Antioxidants can act within the skin to block the effects of free radicals regardless of the type of pollutant producing them.

Pollushield functional ingredient combines a polymer with metal chelating properties and a powerful antioxidant that scavenges free radicals. As a result, this anti-pollution ingredient can limit accumulation of environmental pollutants within the skin and also enhance the self-defensive capability of the skin, as it has been proven by means of the following studies.

Protecting keratinocytes from urban dust

To evaluate the protective effect on skin cells, human epidermal keratinocytes from adults (HEKa) were incubated for 24 hours with acrylic acid/acrylamidomethyl propane sulfonic acid copolymer and dimethylmethoxy chromanol at concentrations equivalent to 0.5% Pollushield functional ingredient, while non-treated cells were used as a control. Then, 100 µg/ml urban dust, consisting of atmospheric particulate material collected in a city, was added and incubated with the cells. After 24 hours, cellular viability was evaluated through the colorimetric method based on the reduction of 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT). Epidermal cells were protected despite the presence of urban dust, with a viability that was 47.9% higher when treated with the cosmetic ingredient.

Anti-pollution activity on living skin explants

Human skin explants maintained with culture medium were treated with 5% Pollushield in carboxymethyl cellulose (CMC) aqueous gel or with CMC aqueous gel alone. The CMC gel is used because it provides the appropriate viscosity for the ingredient to stay in contact with the skin. The explants were treated once a day for four days, whereas non- treated explants were used as a control. 4 hours after the last treatment, the explants were exposed to a pollution mix containing heavy metals, hydrocarbons and diesel particles, for an additional 24 hours.

Skin morphology

Skin sections were stained with the Masson's trichrome, Goldner variant method. Then, cell and tissue morphology were visually evaluated by a trained expert. When applying our functional ingredient to the explants, it helped to preserve normal morphology in pollution-exposed skin (figure 1), maintaining density of the dermal collagen network (green staining) and typical morphology of epidermal and dermal cells (purple staining).

Expression of metallothionein

Protein metallothionein (MT-1H) was used as a marker of exposure to metals and oxidative stress. This protein was detected on skin tissue sections by means of immunostaining (figure 2**) and its levels were visually evaluated by trained experts. MT-1H was not increased despite the presence of toxic sub-

photos: Lipotec

stances, suggesting that the ingredient protects the skin.

Number of Langerhans cells

Glycoprotein CD1a, which is specifically expressed by Langerhans cells, was detected through immunostaining and quantified on skin tissue sections (figure 3**). The total amount of Langerhans cells diminished significantly in skin exposed to pollution. However, with the anti-pollution ingredient, the number of these cells was higher (32.4%) compared to non-treated skin.

Lipid peroxidation

The degree of oxidation of skin lipids was assessed using an enhanced method of the thiobarbituric acid reactive substances (TBARS) assay. The concentration of the marker for oxidative stress malondialdehyde (MDA) in the explants medium was quantified and it was 37.4% lower in pollution-exposed skin pre-treated with the ingredient compared with non-treated skin.

Skin protection from urban pollution

To assess the protective effects of the ingredient in an urban environment, a clinical test was performed in a panel of 20 Asian female volunteers, between the ages of 26 and 62, who were outdoor workers in Beijing, China. The subjects applied a cream containing 5% of our new functional ingredient to half of the face and a placebo cream to the other half, according to a randomization scheme.

Build-up of metals

At the beginning of the study, skin samples obtained through tape stripping were obtained to measure basal levels of metals. Then, the volunteers applied the creams and spent six hours in city traffic. Finally, skin stripping was performed to obtain new samples of the epidermis. Metals were extracted from skin samples and, by means of graphite furnace atomic absorption spectroscopy, the following were analyzed: iron, lead, chromium, nickel, and zinc. Variations in metal levels with respect to basal conditions were calculated (figure 4).

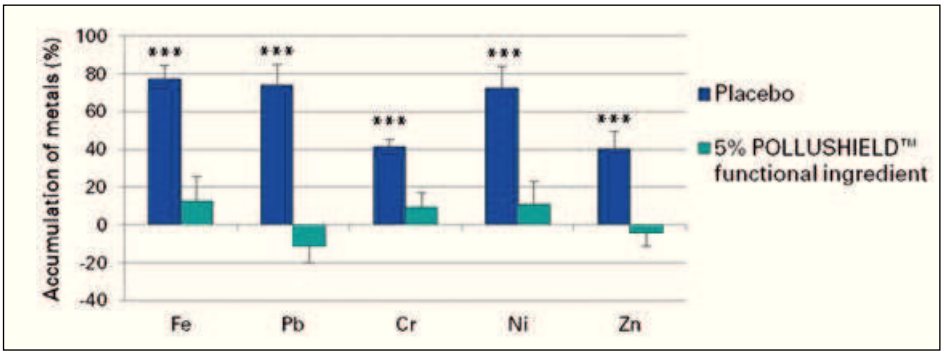

Fig. 4 Change in the concentrations of metals in the skin after six hours of exposure (***p<0.001)

All metals evaluated increased significantly after exposure to pollution, but only in the skin treated with the placebo. This was not observed in skin treated with the active cream ($p < 0.001$).

Antioxidative capacity and lipid peroxidation

After 15 and 30 days of product application and regular exposure of the volunteers to city pollution, skin samples were taken by means of tape stripping and analyzed. The antioxidant capacity of the skin was assessed by the ferric reducing antioxidant power (FRAP) method, while lipid peroxidation was determined by means of the MDA assay. In the skin that was treated with the cream containing the active ingredient, the antioxidative capacity was improved and the level of lipid peroxides decreased (figure 5).

Binds metals and improves skin's antioxidative capacity

Pollushield functional ingredient offers the benefits of a polymer that can bind toxic metals and the aid of a strong antioxidant. The ingredient has been shown to maintain the viability of epidermal cells exposed to urban dust. In addition, it protects skin exposed to contaminants, with a preservation of morphology and reduced peroxidation, together with lower levels of damage markers. A single application of this functional ingredient in volunteers exposed to urban pollution provided quick protection against heavy metals deposition in the skin, while its continued use replenished the antioxidative pool of the skin suggesting a better capacity to resist oxidative stress, which was also shown as reduced lipid peroxides. □

DOWNLOADS

Additional information at
www.cossma.com/qr00093
Your access codes for **April**:
User name: **cossma4**
Password: **body**

* Pollushield is owned by The Lubrizol Corporation or its affiliates

The figures 2 and 3** as well as references can be found on the Internet – see download panel

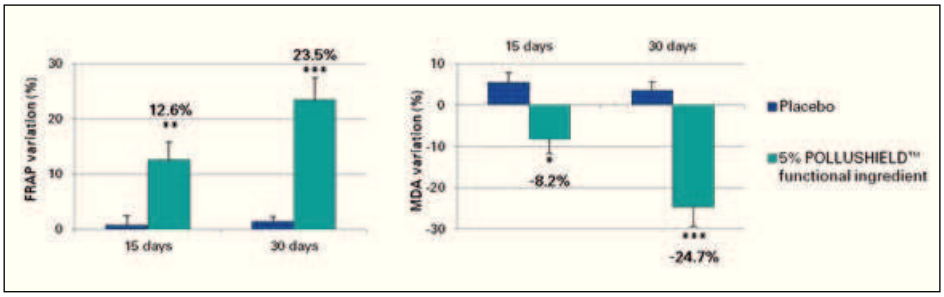

Fig. 5 Changes in skin antioxidant capacity and lipid peroxidation (*p<0.05; **p<0.01; ***p<0.001).

figures: Lipotec

E51280

COSSMA

4 / 2016

COSMETICS | SPRAY TECHNOLOGY | MARKETING WWW.COSSMA.COM

Jonna Jalkanen, Sophie la girafe Cosmetics

"AFFORDABLE QUALITY"

GO FUTURE: BODY CARE

In-Cosmetics novelties

SPOTLIGHT: FUTURE TRENDS

Health is beauty

VIP of the Month

DR JAMIE HAWKES
Lonza, talks about the new global centre for hair care technology