THE NATURAL SOLUTION TO POLLUTION

Anti-ageing ingredients | A multi-component active ingredient based on plant extracts and natural phospholipids targets three mechanisms to naturally reduce pollution-induced skin stress and strengthen the endogenous detoxification machinery.

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Anti-pollution is no longer just an urban trend. Combating pollution-induced skin damage will be a fundamental focus of the cosmetic industry in the next decades. The awareness of pollutant damage to the skin is not just prominent in populous and polluted cities in Asia any more. The consciousness that even low levels of air contaminants promote skin ageing and damage has reached western countries.

HerbaShield URB is a **Cosmos**-approved multi-component active ingredient based on plant extracts and natural phospholipids. Aqueous-alcoholic extracts are embedded in a matrix of phospholipids and maltodextrin, resulting in an easy-to-use powder that combines the benefits of phospholipids and botanical extracts. The active ingredient, based on watercress, horsetail and nettle, targets three mechanisms to naturally reduce pollution-induced skin stress:
1. strengthening the skin barrier with hydrogenated lecithin;
2. enhancing the endogenous detoxification machinery with active ingredients from plant extracts;
3. additional cell protection due to high antioxidative capacity, see fig. 1 lead photo.
Particulate matter functions as a carrier of pollutants and favours the accumulation of harmful substances such as polycyclic aromatic hydrocarbons (PAH)[1,2]. Excessive exposure

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to pollutants and the concomitant defence responses give rise to oxidative stress and become, therefore, drivers of skin disease and ageing[3,4].

Supplying antioxidants is not enough

In fact, air pollutants induce the formation of wrinkles and spots, increase the excretion of sebum, and weaken the skin barrier[5-7]. The most promising anti-pollution strategy is the activation of the body's endogenous detoxification machinery, which is composed of a multitude of cell-protective and detoxifying enzymes. These components are powerful enough to neutralise thousands of toxic molecules every second. By contrast, the mere application of antioxidants is less efficient, as one molecule of antioxidant only neutralises one free radical.

Harnessing the power of the skin's detoxification

The skin constitutes the protective layer of the body. However, PAH can penetrate this barrier. This is why the skin has a potent, two-phase detoxification machinery (fig. 2). In phase I, pollutants are activated for further processing, but become toxic. The AH-receptor (AHR), a pollutant sensor, constitutes the starting point and orchestrates several enzymes that activate the pollutants for further processing[8,9]. This reaction generates destructive intermediates and reactive oxygen species (ROS) as by-products[10]. Therefore, a stimulation of phase I is harmful, if the reactive intermediates and ROS cannot be adequately detoxified[11]. In phase II, the reactive intermediates are transformed into excretable products[12]. This final detoxification step is controlled by the transcription factor NRF2[9]. NRF2 not only ensures a rapid detoxification of reactive intermediates from phase I, but also initiates antioxidant defence in order to minimize oxidative stress. Therefore, the activation of NRF2 and a shift of the phase I/II balance in favour of phase II, represents a promising anti-pollution approach[13,14].

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Implementing the consumer's concerns about **pollution into skin care solutions** is key

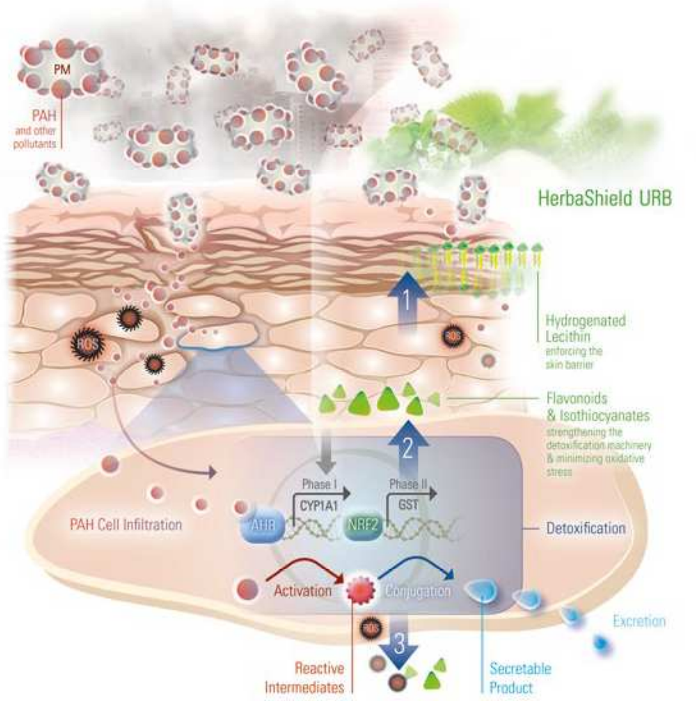

fig. 2: Relieving and strengthening endogenous detoxification

The return of highly-valued detox plants

The active ingredient, based on watercress, nettle, and horsetail, is fully in line with the demands made above and thus has great potential to protect the skin from pollutant-induced skin-ageing – particularly when embedded into a matrix of hydrogenated lecithin. Watercress (nasturtium officinale), which was announced the healthiest food in the category of fruits and vegetables in 2014[15], is considered a metabolic fuel and is recommended for spring detoxification regimens. The detoxifying effect is predominantly ascribed to isothiocyanates[16-18].
Nettle (urtica dioica) is celebrating a comeback in beauty regimens and is increasingly used in purging and detox regimens[17].

The active components are flavonoids, in particular quercetin, which has the ability to enhance the activity of NRF2[9].
Horsetail (equisetum arvense) possesses antioxidant and anti-inflammatory properties[19] and has a positive influence on the cellular resistance to oxidative stress. Flavonoids, in particular, kaempferol, quercetin and protogenkwanin glycosides, are listed as the primary active ingredients[18-20].
Hydrogenated phospholipids (hydrogenated lecithin) possess physical properties that are comparable to those of the components of the skin[21,22]. Hydrogenated lecithin is suitable to stabilise the barrier and provides a two-fold protection: firstly, it preventively strengthens the skin barrier against environmental stressors such as pollutants and secondly, it regenerates and restores the barrier upon pollutant-induced damage.

Results of efficacy studies

The following section highlights some of the efficacy studies that have been performed with the help of phytochemical analysis.
Flavonoid fingerprint analysis using high performance thin layer chromatography (HPTLC) revealed substantial amounts of various flavonoids. The flavonoid

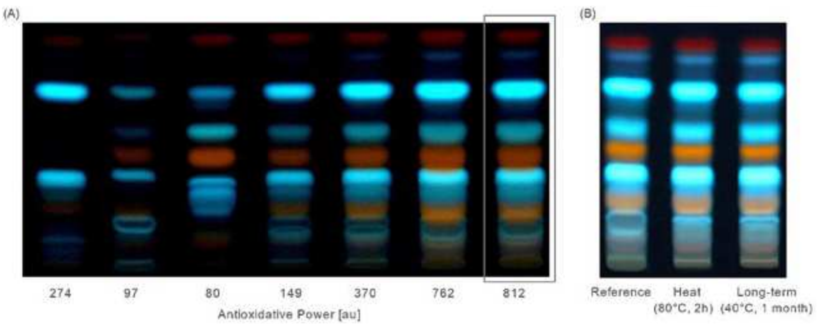

fig. 3: The HPTLC flavonoid fingerprints illustrate the constant optimisation of the extraction profile and the antioxidative power

content correlated with antioxidative power, which was quantified by ESR spectroscopy. HPTLC analysis also demonstrated adequate heat and storage stability: heating to 80°C for 2 hrs or storage at 40°C for 1 month had no effect on the overall flavonoid pattern (fig. 3). The HPTLC flavonoid fingerprints illustrate the constant optimisation of the extraction profile and the antioxidative power – from early prototypes (fig. 3 a , left) to the final active ingredient (fig. 3 a, right). Flavonoid fingerprints under control, heat, and long-term storage conditions can be seen in fig. 3 b.

Empowering the skin's detoxification machinery

The incubation of human keratinocytes with the active ingredient stimulated NRF2 activity, demonstrating that the ingredient indeed boosts the skin's detoxification machinery. Cells stressed with benzo[a]pyrene (BaP), one of the best-known pollutants, showed higher NRF2 activity than unstressed cells, suggesting that the detoxification gears up under environmental stress. Notably, the active ingredient also provided additional detoxification power under this situation of elevated environmental stress. To conclude, the active ingredient allowed skin cells to cope even better with pollutant-induced stress (fig. 4*).

Protecting against pollutant-induced skin damage

The incubation of human keratinocytes with particulate matter or BaP induced massive oxidative stress: the formation of intra-cellular ROS was increased threefold and was even higher than after incubation with 1 mM H_2O_2. Unstressed cells produced low amounts of free radicals and, thus, showed low fluorescence. Cells incubated with BaP showed a high fluorescence level, indicating excessive oxidative stress. Oxidative stress was completely prevented through treatment with the active ingredient. Notably, the active ingredient completely inhibited the formation of excessive radicals following contact with pollutants. To conclude, the active ingredient reduces the negative effects of pollutant exposure; in particular, fewer free radicals are formed. This implies a substantial anti-ageing effect (fig. 5* and 6).

> "COMBATING POLLUTION-INDUCED SKIN DAMAGE WILL BE A FUNDAMENTAL FOCUS OF COSMETICS IN FUTURE"
>
> Stefan Bänziger, Head of R&D and Engineering, Lipoid Kosmetik

Counteracting pollutant-induced skin ageing

Pollutants impair the components of the skin. This eventually induces the formation of wrinkles, drives the development of a dull and uneven skin tone, favours the occurrence of oily skin, and causes skin barrier weakening[6,7]. To assess the active ingredient's efficacy in vivo, we used a lifelike pollution setting by recruiting 2 x 21 female volunteers living in an urban area with smoking habits. One group applied a cream formulation with active ingredient, the other group applied the same formulation without active (placebo) twice a day for 4 weeks.

The application of as few as 1% active ingredient to pollution-exposed facial skin resulted in measurable, visible and noticeable skin benefits: the skin's firmness and elasticity increased. The skin became smoother, as the appearance of fine lines and wrinkles was reduced, both around the eyes and the nose. The overall skin complexion substantially improved, as it became more even and less sallow. The skin got less oily and had a stronger barrier (fig. 7*).

A suitable protection from everyday stressors

Implementing the consumer's concerns about pollution into skin care solutions such as anti-ageing and detoxifying day creams, protective face masks or cleansers, is the future direction of the cosmetic industry. The active ingredient presented here represents a perfect fit for this task: it provides natural and powerful protection against pollutant-induced premature skin ageing and restores a youthful, healthy and even complexion to the face. It is perfectly suitable to protect the skin from everyday stressors and pollutants encountered in urban environments (such as urban dust, diesel combustion products or indoor pollutants) – making us more confident to live in populous – and not pollution-free – cities. □

* fig. 4, 5, 7, the reference list as well as additional information can be found on the Internet – see download panel

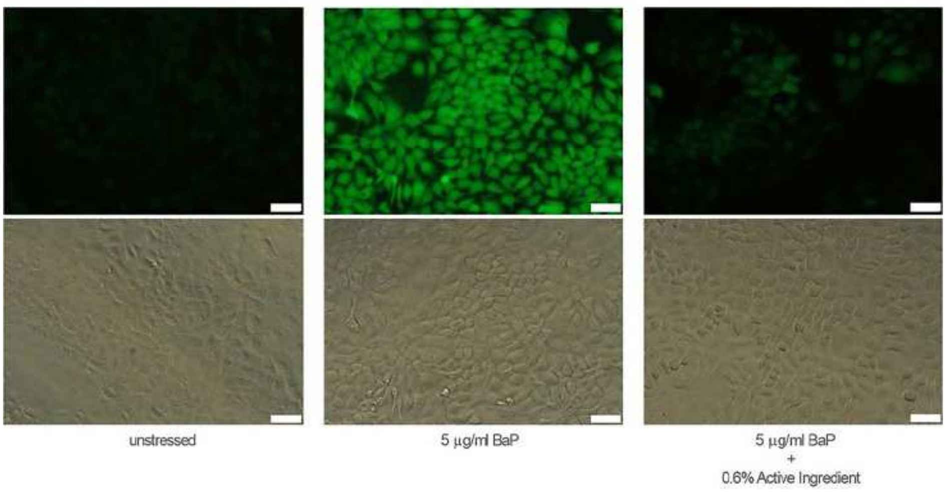

fig. 6: Unstressed cells produced low amounts of free radicals and, thus, showed low fluorescence

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