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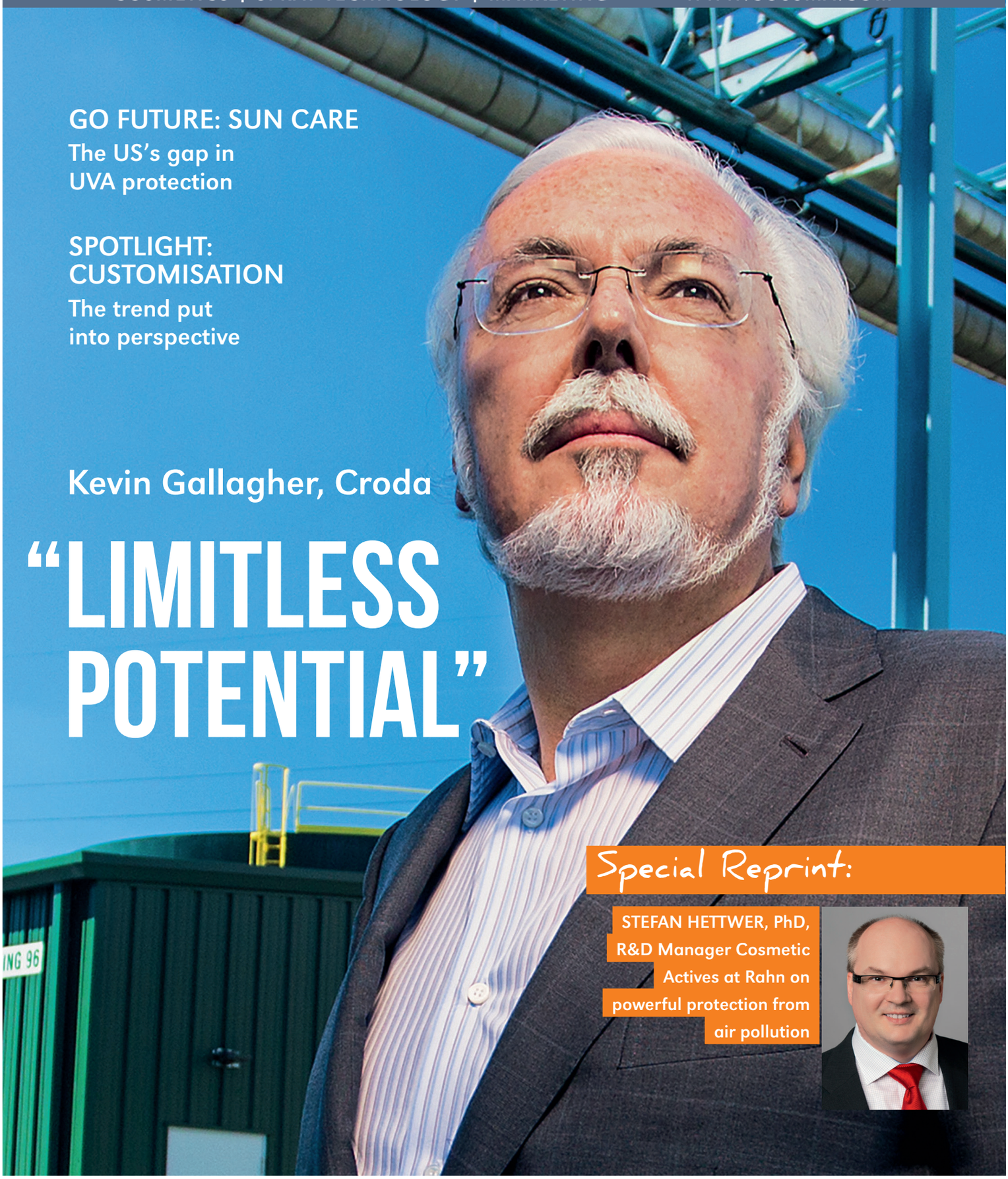

GO FUTURE: SUN CARE

The US's gap in UVA protection

SPOTLIGHT: CUSTOMISATION

The trend put into perspective

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"LIMITLESS POTENTIAL"

Special Reprint:

STEFAN HETTWER, PhD, R&D Manager Cosmetic Actives at Rahn on powerful protection from air pollution

POWERFUL PROTECTION

Active ingredients | Air pollution causes skin ageing. Here we outline the importance of the proteasome to avoid premature ageing caused by air pollutants.

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Why should the epidermis be protected from air pollution? One could argue that there is no special need to protect the epidermal cells from environmental pollution. Keratinocytes are born in the epidermal basal layer and are pushed outward by daughter cells of keratinocyte stem cells. It takes roughly 40 days – depending on your age – for a new-born keratinocyte to end as a scale falling off the skin[1]. This mechanism provides a continuous renewal of the epidermis, pushing any airborne chemicals or particulate matter incorporated into the stratum corneum away from your body. So, is there really a need to protect our skin?

Indeed, some extrinsic factors, especially UV radiation and reactive oxygen species (ROS) are able to penetrate the skin and access sen-

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THE GLOBAL BURDEN OF AIR-POLLUTION

Headlines in 2015 again called our attention to the topic of air pollution. China's CO_2 emissions in 2012 were **600 million tons higher than previously estimated**. This difference already corresponds to **70% of the U.S.'s yearly output**. Additionally, **enormous forest fires** in **Indonesia** caused tremendous air pollution throughout South East Asia.
The global emission of CO_2 is mainly attributable to the massive energy consumption of developed countries. The three regions which generate the **largest amounts of CO_2** are China (29%), the **USA** (15%) and **the European Union** (11%). They are thus responsible for more than **50% of emissions worldwide**. Other countries, such as India, Indonesia and Brazil, are beginning to catch up and are producing growing levels of CO_2 emissions[3].

sitive areas of the epidermis. Therefore, it is of utmost importance to protect the keratinocyte stem cells in the basal layer, as these provide the steady supply of new cells. Additionally, protecting keratinocytes in the granular layer is key for a proper natural skin barrier function, as these cells release the natural moisturizing factor (NMF) and important fatty acids into the stratum corneum.

Key role of the proteasome

The proteasome manages the fate of proteins in a cell. The proteasome degrades misfolded proteins, protein aggregates and proteins which have fulfilled their obligations as they can cause serious malfunctions. To prevent inadvertent removal of intact or still-necessary proteins, the cell uses ubiquitin as a sophisticated labelling system for waste proteins. In the life cycle of a keratinocyte, there are two crossroads where major changes appear; the proteasome activity is maximized in both.
1.) The keratinocyte stem cells are the source of all keratinocytes. It is known that the proteasome is crucial in maintaining the health status of stem cells[2].
2.) In a later stage, keratinocytes are activated to produce lipids and the natural moisturizing factor (NMF). Here, the proteasome is the main factor for reprogramming the cells and thus is key for a strong skin barrier. Any kind of irritation impeding the proteasome's activity in the epidermis would cause serious changes in the speed of keratinocyte supply or strength of the skin barrier.

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Air pollution linked to skin ageing

A serious problem of air pollution is that NOx undergo reactions in which ozone is formed. This, in its turn, is the main source of free radicals or ROS[6]. In addition to UV radiation, ozone is the main cause of extrinsic skin ageing as it can directly penetrate the skin and attacks all cells in the epidermis. It induces deleterious crosslinking reactions with proteins, lipids and metabolites[7, 8] and the formation of the ageing pigment lipofuscin[9]. Several studies have directly linked air pollution to skin ageing and an uneven complexion[10].

Air pollutants inhibit the proteasome

ROS entering the inside of a cell are one cause of lipofuscin generation. Consisting of proteins and lipids responsible for age spots on the skin, the covalently linked aggregates of lipofuscin directly inhibit the proteolytic activity of the proteasome and thus prevent proper cell function[11]. As a consequence, misfolded proteins accumulate as a substrate for new forming lipofuscin and eventually, the cell dies. Heavy metals contained in diesel exhaust particles, a main source of our cities' air pollution, also directly inhibit the proteasome[12, 13]. Making things worse, metal ions can accumulate in lipofuscin and act as an intracellular catalyst that promotes the formation of ROS directly within epidermal skin cells. It is here that ROS can cause the greatest damage[14]. The consequences are ageing of the skin with the usual undesirable ramifications, such as wrinkle formation and loss of elasticity and firmness. Most of us are familiar with the impression of having fatigued, sallow-looking skin after a hard working day in the city. Proper proteasome function imparts a more attractive skin appearance and can counteract the accumulation of damaging debris inside the cell.

Oleuropein activates the proteasome in epidermal skin cells, ensures a continuous supply of keratinocytes and promotes proper keratinocyte function in the stratum granulosum

Proteasome activation as an answer to air pollution

Cosmetic products claiming anti-pollution effects are increasingly appearing on the market. This reflects the soaring awareness of people who are concerned about air pollution and its potential to damage the skin, especially in the Asian countries.
In order to protect the skin against the damaging effects of airborne pollutants, it is important to construct an active barrier to safeguard the skin. **Proteolea**, a cosmetic active ingredient developed

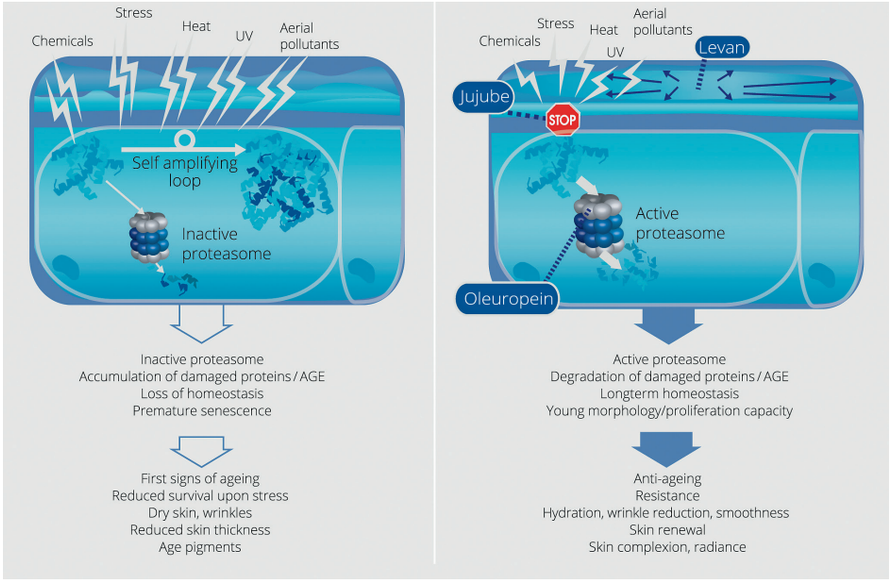

Figure 1: Mode of activity of Proteolea

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by **Rahn,** was designed to activate the proteasome and to fight deleterious ROS in order to maintain proper cell function in stressful environmental conditions. The active ingredient contains a tripartite defence strategy:
1.) The polysaccharide levan acts as a firming and moisturising film, forming a barrier to prevent particulate matter from penetrating the skin.
2.) Extract from jujube fruit contains powerful jujubosides; acting as antioxidants, these eliminate most atmospheric ROS before they can penetrate into deeper epidermal layers.
3.) Oleuropein from olive leaf extract activates the proteasome and maintains proper cell function[15].

Figure 1 shows the mode of activity of Proteolea. On the left, stressors such as chemicals, heat, UV and aerial pollutants stimulate the accumulation of protein aggregates and lipofuscin. Therefore, the activity of the proteasome is reduced. Premature skin ageing with dry skin, wrinkles, reduced skin thickness and age pigments are the consequence. On the right, olive leaf extract with oleuropein strengthens the proteasome and improves the natural recycling process in the skin cells, thus reducing the number of damaged proteins. Extract of jujube strengthens the skin's antioxidative defence system and can even ensure that cellular protein decline does not occur in the first place. The high molecular weight polysaccharide levan creates a tightening film on the skin to protect against particulate matter. A pronounced anti-ageing effect with resistant skin, an improved skin renewal capacity and an even complexion is achieved.

Data on anti-pollution effect

Efficacy data on improvement of ageing parameters such as roughness and wrinkle appearance were already reported elsewhere[16]. The supportive data presented here show that the active ingredient Proteolea acts as an anti-pollution cosmetic ingredient in finished products. As a subjective assessment, 34 subjects aged 40—63 years applied a morning face cream containing 2% of this active ingredient for two months. The focus was set on visible signs of skin stress due to air pollution. Almost the complete panel of study participants (94%) was satisfied with their skin complexion and look after usage of the active ingredient and also found a great improvement in the fatigued appearance of the eye area and drawn facial features. All parameters improved highly significantly in comparison to baseline conditions. This proves a beneficial effect of the active ingredi-

Figures: Rahn

AIR POLLUTION – A HEALTH HAZARD

According to the WHO, air pollution is responsible for **3.2% of disease** recorded throughout the world[4] and very recent investigations suggest **a cost of 1.6 trillion USD a year** due to diseases and deaths caused by air pollution produced by European economies[5]. In addition to noxious gases, such as carbon monoxide and the various nitrogen oxides (NOx), volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs) and heavy metal compounds are present in the air as part of particulate matter. The main sources of these particles are **diesel-fuelled vehicles** and **heating systems that use fossil and even sustainable fuels**. **Despite the considerable efforts** being made in industrialized countries to **reduce the extent of emission of noxious gases and fine particles**, there is a **significant increase** in levels of pollution **worldwide**[3].

ent and a clear benefit for the quality of life of the study participants.

Figure 2 shows the subjective assessment of the study population* for visible signs of air pollution-deteriorated skin appearance. After application of a morning face cream containing 2% cosmetic active ingredients for two months, almost all study participants saw an improvement in uneven complexion and sallow-looking skin. Additionally, the fatigued appearance of the eye area and drawn facial features were highly improved.

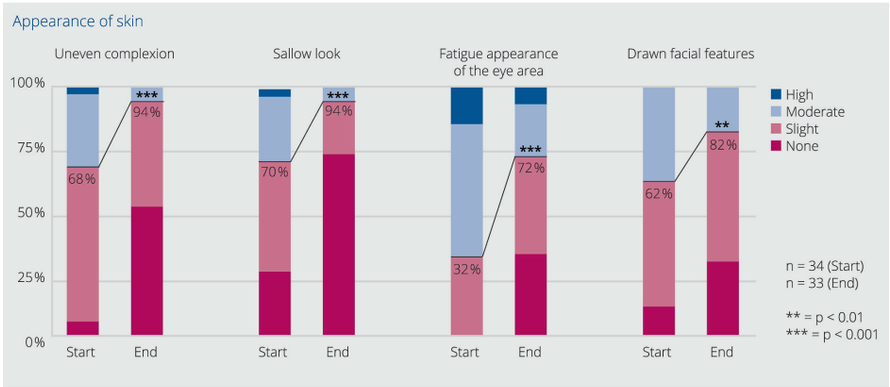

Figure 2: Subjective assessment of air pollution–deteriorated skin appearance

Threefold protection against environmental factors

Proteolea has a three-fold protective effect against damaging environmental factors: With the help of levan and antioxidants from jujube, it provides an active protective barrier against particulate matter and ROS. Oleuropein from olive leaf extract activates the proteasome in epidermal skin cells and ensures a continuous supply of keratinocytes, as well as promotes proper keratinocyte function in the stratum granulosum. This active ingredient's protective function helps to create effective cosmetics for consumers looking for a vivid appearance in our urban environment. □

* 34 study participants were included. Two-tailed, paired t-test. "Slight" and "None" were grouped and "start" and "end" parameters were compared.

References and additional product information can be found on the Internet, see download panel.