BIODERMA

LABORATOIRE DERMATOLOGIQUE

UPDATES ON DERMATOLOGY

JDP 2025

STÉPHANE FAUVERGHE
NAOS Medical Director

EDITO

Dear All,

I am very pleased to present to you a new issue of our Updates dedicated to the latest advancements in Dermatology.

Solar light is both a source of life and a source of cutaneous aggression. Our understanding of the solar spectrum has evolved profoundly: UVB rays are no longer the sole culprits. Long UVA, visible light and infrared radiation all contribute to a cascade of biological damage – oxidative, pigmentary and immunological – whose clinical significance we are now better equipped to appreciate.

This special issue brings together four expert contributions from the BIODERMA symposium at the Journées Dermatologiques de Paris 2025.

Prof. Marie-Thérèse Leccia *(Grenoble , France)* provides an overview of the latest advances in solar spectrum research and its effects on the skin, before setting out practical recommendations for effective, personalised photoprotection – incorporating the emerging concept of photo-pollution, which calls for a rethinking of protective strategies in an increasingly degraded urban environment.

Prof. Khaled Ezzedine *(Créteil, France)* outlines the mechanisms underlying post-inflammatory hyperpigmentation: the pivotal role of blue light *via* opsin-3, sustained melanocytic activation, and the crosstalk between keratinocytes and melanocytes. He proposes a practical diagnostic and therapeutic algorithm, emphasising that tinted photoprotection is now an indispensable cornerstone of management, particularly in darker skin phototypes.

Finally, **Karine Torrelli, PharmD *(NAOS, Lyon, France)*** presents BIODERMA solutions developed in line with NAOS's ecobiology philosophy: supporting the skin's natural biological mechanisms rather than overriding them, with PHOTODERM XDEFENSE ULTRA-FLUID SPF50+, PIGMENTBIO C-CONCENTRATE and PHOTODERM M SPF50+.

What unites these contributions is a shared conviction: that skin can no longer be protected in a one-size-fits-all manner. The future of photoprotection lies in an approach that embraces phototype diversity, the full solar spectrum, and the environmental challenges of everyday life.

SCIENTIFIC PROGRAMME

SPEAKERS
SHORT BIOGRAPHIES

KHALED EZZEDINE
(FRANCE)

Khaled Ezzedine is a Physician, Professor of Dermatology, holder of a PhD in Epidemiology, and a Habilitation to Supervise Research in Epidemiology.

In 2008, he joined the National Reference Center for Rare Skin Diseases in Bordeaux, CHU De Bordeaux. He is also a researcher attached to the joint research unit INSERM U1153/INRA U1125 at the University of Paris 13. His major themes of interest are pigmentation disorders including vitiligo and ethnic skin disorders, skin aging and the search for its determinants, attitudes and practices towards sun exposure and the construction of quality of life scales.

Appointed Professor of Dermatology at the University of Paris Est Créteil since 2015, he has joined the dermatology department of the Henri Mondor Hospital.

To date, he has authored more than 220 scientific articles and book chapters, including nearly 200 publications listed in PUBMED. He has been Associate Editor of the British Journal of Dermatology in the Epidemiology section since 2015. In addition, he is a reviewer for several reputable medical journals, such as the Lancet, British Journal of Dermatology, JAMA Dermatology and Journal of the European Academy of Dermatology and Venereology, Journal Of the American Academy of Dermatology, Journal of Investigative Dermatology among others.

MARIE-THÉRÈSE LECCIA *(FRANCE)*

Marie-Thérèse Leccia, MD, PhD, is a dermatologist specialising in Allergology and Photobiology at Grenoble University Hospital. She has conducted extensive experimental and clinical research on skin cancers and photobiology, focusing on UV radiation-induced skin damage, including Photocarcinogenesis and photoaging, as well as photoprotection.

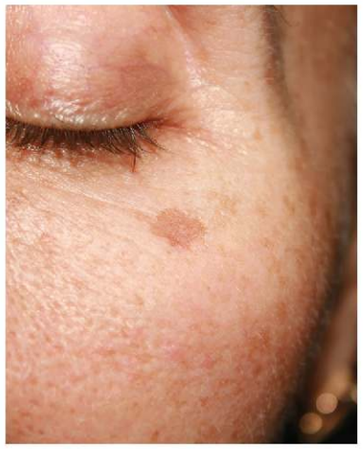
An active member of the French Dermatological Society (SFD) and the French Photodermatological Society (SFPD), she also led the French Skin Cancer Group of the SFD for several years. Since 2020, she has served as President of the Medical Community at Grenoble University Hospital and Vice-President of the National Medical Community of University Hospitals in France.

THE SOLAR SPECTRUM AND THE SKIN: WHAT'S NEW?

PROF. MARIE-THÉRÈSE LECCIA
Dermatologist, Grenoble Alpes University Hospital, France

INTRODUCTION

The skin is a complex system that integrates its purely physical barrier function with immunological and microbiological dimensions that are closely interconnected. The skin is the site of significant inflammatory and immunological reactions in response to sun exposure; the cutaneous microbiome contributes to this barrier function by modulating the potentially harmful effects of solar radiation, particularly UV radiation. Other environmental factors, such as pollution and hydrological factors, as well as lifestyle factors (diet, alcohol consumption and smoking) and the medical context —including medication use— play a determining role in the skin's response to sun exposure.

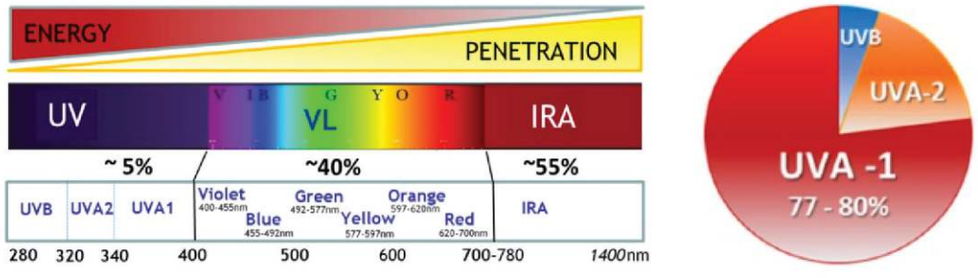


For a long time, the most studied part of the solar spectrum was that of UV radiation. UV rays induce DNA mutations through direct absorption (pyrimidine dimers) or *via* photosensitisation by generating reactive oxygen species (oxidative damage such as 8-OHdG). More recently, studies have focused on long UVA (UVA1, between 340 and 400 nm) and visible light, particularly in the range of 380–500 nm corresponding to blue light, which is implicated in pigmentary disorders. These wavelengths are less energetic but penetrate more deeply into the dermis. Research has shown that UVA1 could represent up to 80% of active UV radiation.

In real-life conditions, the skin is exposed to the entire solar spectrum (including infrared), and the different wavelengths interact to determine the biological and clinical effects observed.

Sunlight also has beneficial effects, used for example in phototherapy —through the immunomodulatory properties of UV— or *via* vitamin D synthesis in the skin under the action of UVB.

Figure 1.
Solar spectrum and impact of UVA1 on skin UV exposure, after Bernerd *et al.* 2022.



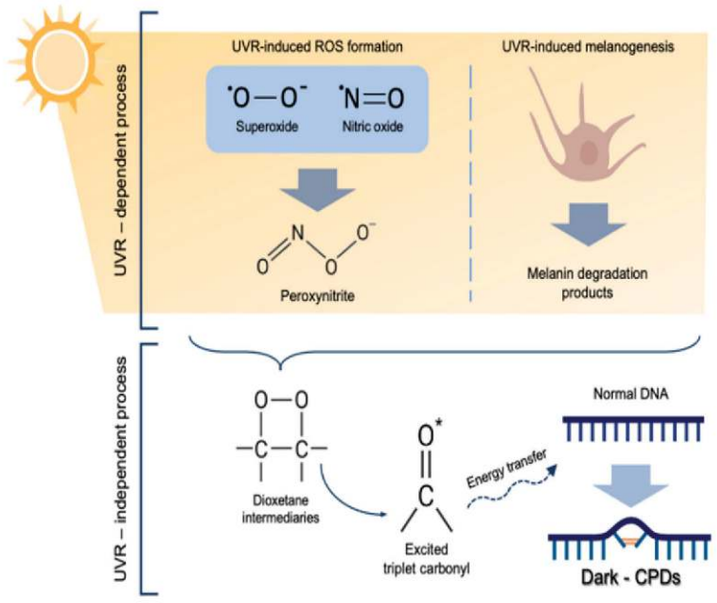
A recent study examined DNA damage (pyrimidine dimers and 6-4 photoproducts) and repair systems (p53) induced by sub-erythematous UV doses in patients from two age groups (18–40/50 and 50/55–70 years), with both fair (ITA > 41°) and darker (ITA < 28°) phototypes. The results showed, at 24 hours and 7 days post-exposure, increased DNA damage and reduced repair capacity with age. Surprisingly, darker skin types showed increased DNA lesions and impaired repair at 24 hours compared with fair skin, with restoration of capacity at 7 days. The results also showed that there is not necessarily a correlation between ITA and the measured MED in darker skin types. **These findings prompt reflection on photoprotection for darker skin types, even though the risk of skin cancer is lower.**

Recent work has explored the impact of blue light on the repair of UVB-induced pyrimidine dimers (CPD and 6-4 PP) in a reconstructed skin model. **Pre-exposure to blue light leads to reduced skin repair capacity, a reduction that can be prevented by a specific anti-blue light filter.**

UVA1 and visible light (VL), particularly high-energy violet-blue wavelengths (HEV), induce or worsen hyperpigmentation. UVA1 and HEV have an additive effect, with a significant contribution from the longest UVA1 rays (370–400 nm). Pigmentation measured 24 hours after exposure is attributed 71% to blue light (400–500 nm), for which VHE (400–450 nm) represents 47%; 37% to green light (500–600 nm); and 36% to green + red (500–700 nm). Infrared does not appear to have any effect on hyperpigmentation.

Recent studies have focused on "dark" CPDs (dCPDs) — DNA lesions induced after solar irradiation. In melanocytes, melanin oxidation phenomena appear to play a role in the formation of these dCPDs, whose

Figure 2.
Molecular mechanisms involved in dark-CPD formation, after Portillo-Esnaola *et al.* 2021.
UV rays induce ROS formation, particularly superoxide ions and nitric oxide, which can form peroxynitrite. Melanin degradation products, also caused by UV exposure, can interact with peroxynitrite to form dioxetane intermediates, which decompose into two carbonyls, one of which is an excited-state triplet carbonyl. These high-energy triplet carbonyls transfer their energy to DNA bases, leading to CPD formation after sun exposure.



biological effects are not yet fully understood. dCPDs have also been detected in melanin-free systems, indicating the involvement of other unknown formation processes. In fair skin, CPDs are uniformly distributed throughout the epidermis, whereas in darker skin types, CPD content is reduced in the deeper layers of the skin where melanin concentration is highest. **The type (eumelanin/phaeomelanin) and location of melanin may therefore modulate dCPD formation.**

Certain antioxidant molecules appear capable of preventing the formation of dCPDs.

UV radiation can modify the cutaneous microbiome by acting on lipid metabolites and on inflammatory and cell proliferation pathways, both locally and systemically. **Conversely, the microbiome has an adaptive capacity and appears to be capable of establishing anti-UV protective systems.**

CONCLUSION

Beyond genetic background and medical context, the skin's response to sun exposure also depends on other environmental and behavioural factors that must be properly assessed and taken into account for a comprehensive approach to photoprotection.

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POST-INFLAMMATORY HYPERPIGMENTATION

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INTRODUCTION

Post-inflammatory hyperpigmentation (PIH) refers to pigmentary lesions that develop secondary to inflammation. They may be epidermal or dermal and are observed preferentially in individuals with darker skin phototypes (IV to VI), occasionally in phototype III, and almost never in fair phototypes (I–II).

This is explained by the fact that darker skin types have larger, more numerous and more widely distributed melanosomes and that their physiological photoprotective mechanism is more active (with greater pigment production).

— Mechanisms —

PIH is an inflammatory phenomenon involving light, in which the crosstalk between cellular components — keratinocytes, melanocytes and "photo-aged" fibroblasts — is central. Interleukin (IL)-1, IL-6, tumour necrosis factor (TNF)-α, increased MITF expression (microphthalmia-associated transcription factor involved in melanocyte development) and oxidative stress are the inflammatory mediators involved in PIH.

Visible light plays a major role, particularly blue light (380–500 nm), which is insufficiently addressed by conventional sunscreens (filtering wavelengths up to 420–440 nm), whilst the higher wavelengths of blue light — up to 500 nm — penetrate more deeply, almost to the hypodermis. The longer the wavelength, the greater the depth of skin penetration.

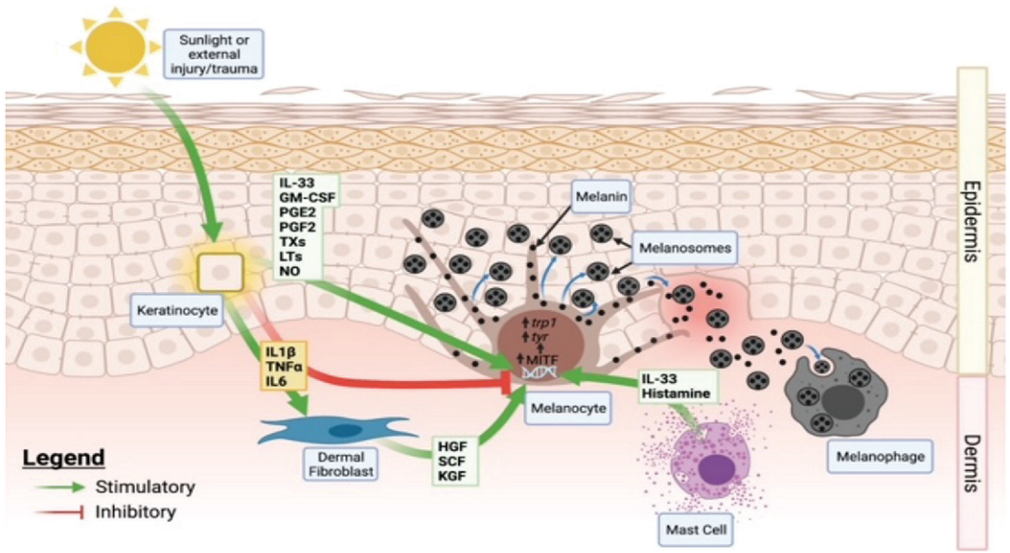
Following injury, keratinocytes rapidly secrete pro-inflammatory cytokines (days 1–3) to initiate healing. Between weeks 1 and 3, these cytokines activate melanocytes and thus melanosomes production. These melanosomes are subsequently degraded by macrophages to form melanophages — a mechanism partly responsible for PIH.

This is why photoprotection is paramount between day 1 and week 3.

Blue light stimulates melanin synthesis *via* opsin-3, a key melanocyte "photoreceptor", leading to the formation of a protein complex involving tyrosinase and dopachrome tautomerase — key enzymes in melanogenesis. This complex, formed primarily in the melanocytes of darker skin types, drives sustained tyrosinase activity, thereby explaining the persistent hyperpigmentation observed.

Visible light has also been shown to contribute to ageing by activating matrix metalloproteinases, reducing collagen production and inducing reactive oxygen species (ROS). It is capable of inducing a more intense and more lasting pigmentation than UVA1. **Only darker skin types respond to visible light irradiation, whilst fair phototypes (I and II) show no induced hyperpigmentation. Blue light induces hyperpigmentation whilst red light (630 nm) has no effect on pigmentation.**

Figure 1.
Mechanisms of PIH, after Maghfour *et al.*



— Prevention, Recommendations and Treatment —

Photoprotection against UV and visible light is essential for PIH prevention. Tinted filters containing iron oxide should now be considered the gold standard for treatment and prevention. They must be applied daily and reapplied throughout the day.

For acne, the American Academy of Dermatology recommends early treatment in patients with darker phototypes to limit PIH: retinoids and benzoyl peroxide as first-line treatments, to which depigmenting agents (such as hydroquinone and azelaic acid), antioxidants or a gentle peel may be added where PIH is already present, along with systematic tinted photoprotection.

Hydroquinone remains the topical treatment of reference for PIH, though other treatments may be used, including azelaic acid, retinoids, niacinamide and dermo-cosmetic depigmenting agents.

With regard to procedures, gentle peels or laser treatments may be used but with caution in darker phototypes due to the inflammation induced by certain procedures. A recent study demonstrated the benefit of peeling in the treatment of acne scarring using fractional CO_2 laser resurfacing on target areas and post-inflammatory hyperpigmentation severity (PIHASI).

Not all hyperpigmentation is necessarily PIH. The diagnostic algorithm for PIH centres on the presence or absence of an inflammatory history preceding the hyperpigmentation.

In the absence of an inflammatory history, the differential diagnosis may include lichen planus pigmentosus, Riehl's melanosis, erythema dyschromicum perstans, periorbital hyperpigmentation or hyperpigmented mycosis fungoides. When there is a clinical history of inflammation preceding the hyperpigmentation, the diagnosis is confirmed. The location of the pigmentation — epidermal, mixed or dermal — is assessed using Wood's lamp and treated accordingly.

Figure 2.
Algorithm for the diagnosis and treatment of PIH, after Chaowattanapanit *et al.*

For epidermal hyperpigmentation, first-line treatment is Kligman's triple combination; for mixed pigmentation, the epidermis is treated first followed by the dermis; and for dermal pigmentation, laser treatment is employed. Whatever the grade of PIH, all treatment is accompanied by UV and visible light photoprotection.

— Acne & PIH —

Acne in darker skin types has a characteristic clinical presentation: prominent dyschromia, often subtle papulopustular lesions, a shiny complexion and a higher risk of keloids. In this population, PIH and its treatment are frequently the primary reason for consultation, ahead of acne management itself. Acne management should follow standard protocols, despite the frequent poor tolerance of topical treatments and the risk of severe hypersensitivity syndrome with minocycline. Isotretinoin may be considered for mild-to-moderate acne. Given the risk of dyschromia, evening application should be preferred, starting with low concentrations and favouring creams over gels, with applications on alternate days if signs of intolerance occur.

CONCLUSION

Before initiating any management, it is important to identify the origin of the PIH. The use of anti-UV and anti-blue light tinted photoprotection is essential, even if it affects the visual appearance (grey tint) and may limit adherence in some patients. The efficacy of combination treatments for PIH is superior to that of monotherapies. Recent experimental models will undoubtedly guide and accelerate therapeutic innovation.

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PHOTOPROTECTION: WHAT'S NEW?

PROF. MARIE-THÉRÈSE LECCIA
Dermatologist, Grenoble Alpes University Hospital

INTRODUCTION

Effective photoprotection prevents the harmful effects of the sun, both acute effects such as sunburn (actinic erythema) and, above all, long-term effects including skin cancers, photoageing (helioderma) and associated pigmentary disorders.

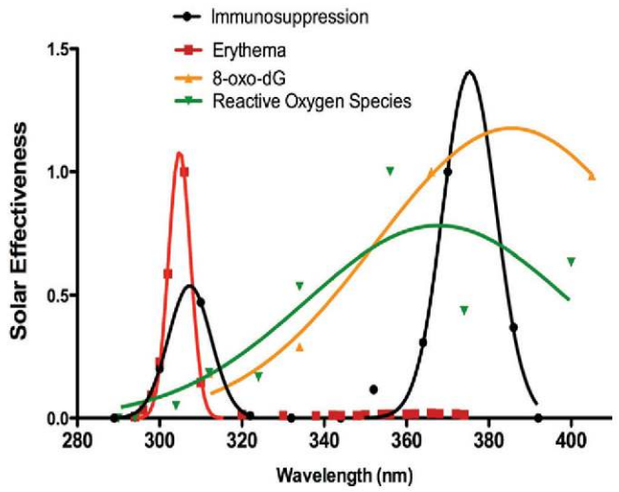
To be effective, photoprotection must cover the entire solar spectrum in order to protect against the full range of ultraviolet (UV) radiation. It has been demonstrated that both UVB and UVA rays induce different types of potentially mutagenic DNA damage and degrade other cellular components (lipid membranes, proteins), notably through the production of reactive oxygen species. With repeated and/or excessive exposure, DNA repair systems and antioxidant defences become impaired. Longer wavelengths corresponding to UVA1 (340–400 nm) and visible light (400–700 nm, particularly blue light at 380–500 nm) contribute to UV-induced damage, especially in the dermis. UV exposure also induces local and systemic immunosuppression.

— Photoprotection: A Public Health Priority —

From a public health perspective, it is **important to recall that skin cancers are the most common cancers in humans and that the harmful effects of the sun on the skin begin very early, from childhood onwards.**

In order to reduce the risks associated with sun exposure, dermatologists have an important educational role to play with their patients and with the general public. Messages must be clear, tailored to the target audience and delivered at every available opportunity during consultations.

Figure 1.
Biological effects of sunlight according to wavelength, after Halliday *et al.*



Current best practice recommendations include: seeking shade during peak sunshine hours, wearing protective clothing and accessories (caps, wide-brimmed hats, sunglasses) and applying a sun protection product (SPP) — providing both UVB and UVA protection — regularly to exposed areas. The choice of protection factor and formulation type (cream, lotion, spray, stick) should be personalised according to the individual's skin phototype, medical history and sun exposure context.

Children are a high-risk population with significant sun exposure, particularly during school breaks and sporting activities. Sun safety awareness should be promoted in schools from the earliest age, in partnership with the national education system, through initiatives such as "healthy schools" programmes and health service placements carried out in secondary schools by health students. Such education must be accompanied by strong public policies to encourage the creation of shaded areas in schools and sports facilities.

— Photoprotection: Key Messages and Products —

The dermatologist's message must be clear and tailored to each individual, considering their professional and social context and lifestyle, particularly leisure activities. The choice of SPP is classically based on skin phototype, the location and nature of sun exposure, and takes into account medical and dermatological history. A good practice guide for sun protection products has been validated by the scientific community, industry and health authorities (ANSM, Good Practice Guide for Sun Protection Products, July 2017).

The dermatologist advises on the most appropriate formulation for different body areas (cream for the face, lotion or spray for the body, stick for the lips and scars) and on application methods in terms of quantity and frequency to ensure optimal protection.

SPPs combine chemical and/or mineral filters — compliant with European regulations — together with other photoprotective ingredients, often antioxidants, intended to stabilise filters, reinforce protection against oxidative stress, or support DNA repair against UV and visible light. However, a recent study reported that only 2% of these ingredients have clinically demonstrated efficacy. Among these, iron oxide is notable for its ability to limit visible light-induced pigmentary disorders.

In 2021, an expert panel published recommendations for clinicians regarding the preferred choice of SPPs in routine practice, considering pigmentary disorders and the need for protection against visible light.

Figure 2.
Selection and correct use of sun protection products *(ANSM, July 2017)*

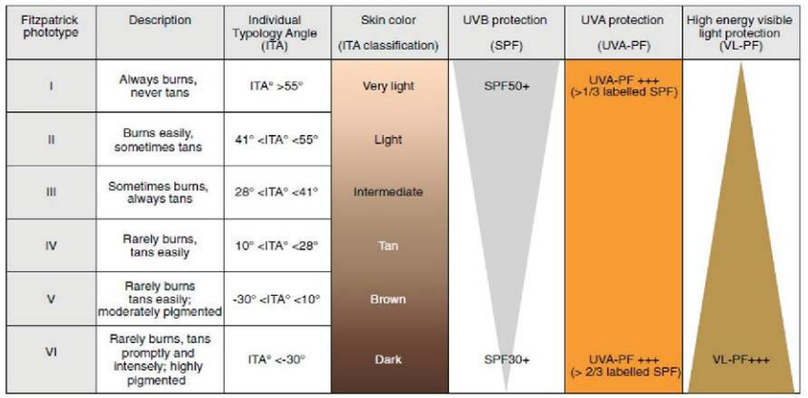
Moderate exposure	☀	Outdoor daily life
High exposure	☀☀	Beaches, extended outdoor activities
Extreme exposure	☀☀☀	Glaciers, tropics

	Moderate exposure ☀	High exposure ☀☀	Extreme exposure ☀☀☀
Extremely sun-sensitive skin	High Protection (SPF 30–50) + UVA	Very High Protection (SPF 50+) + UVA	Very High Protection (SPF 50+) + UVA
Sun-sensitive skin	Medium Protection (SPF 15–20–25) + UVA	High Protection (SPF 30–50) + UVA	Very High Protection (SPF 50+) + UVA
Intermediate skin type	Low Protection (SPF 6–10) + UVA	Medium Protection (SPF 15–20–25) + UVA	High Protection (SPF 30–50) + UVA
Fairly resilient skin	Low Protection (SPF 6–10) + UVA	Low Protection (SPF 6–10) + UVA	Medium Protection (SPF 15–20–25) + UVA

Photoprotection is a perfect example of where personalised medicine is essential. Dermatologists must assess their patients' behaviour and expectations, explain sun protection measures and educate them on the correct use of SPPs.

Beyond consultations, dermatologists have an essential public health role in raising awareness among the general public and younger generations, in collaboration with national education authorities and local communities.

Figure 3.
Guide to SPP selection including visible light protection by phototype, after Passeron *et al.* 2021.



CONCLUSION

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PHOTOPROTECTION AND HYPERPIGMENTATION: THE NAOS ECOBIOLOGY SOLUTION

KARINE TORRELLI
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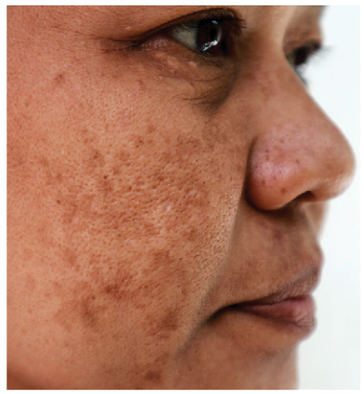
INTRODUCTION

NAOS's philosophy is grounded in the principle of ecobiology, which integrates the skin ecosystem — that is, the interactions between the skin and its environment — and the skin's biological processes. The NAOS approach is therefore based on the use of biomimetic ingredients that are naturally present in the skin or recognised and assimilated by it, the respect of the cutaneous ecosystem, a commitment to acting on the skin's natural mechanisms and the causes of cutaneous dysfunction before addressing their consequences.



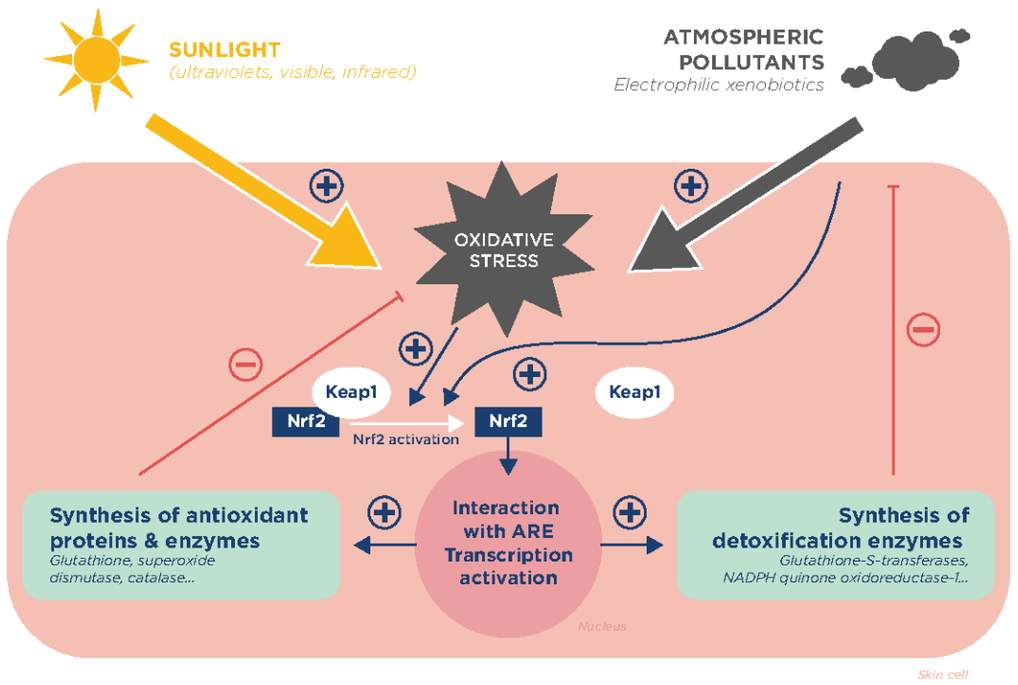
— NAOS and Photoprotection 2.0: activating the Nrf2 pathway —

According to the World Health Organisation's 2024 report, 99% of the world's population lives in a polluted environment and more than half are exposed to increasing levels of pollution. In 2023, only 7 countries met the WHO guidelines on fine particulate matter below 2.5 microns (PM2.5) — the most dangerous particles, as they can enter the bloodstream *via* inhalation. **This exposure to pollution combined with sun exposure has given rise to the concept of photo-pollution, now recognised as a factor in the worsening of inflammatory diseases, cutaneous ageing and pigmentary disorders. Photo-pollution may also be implicated in carcinogenic processes, notably through the interaction between UVA and certain pollutants.** For urban populations, protection against photo-pollution therefore appears essential.

The skin is a complex organ with its own defence mechanisms, particularly those involving the Nrf2 transcription pathway.

The Nrf2 transcription factor is normally inactive within the cell, bound to its natural inhibitor Keap1 in the cytoplasm. In the presence of pollutants or excess reactive oxygen species (ROS), the Nrf2/Keap1 complex dissociates and free Nrf2 can enter the nucleus to induce the expression of over 200 genes — including those involved in the biosynthesis of detoxifying enzymes (such as glutathione-S-transferase, which facilitates xenobiotic elimination, or metallothionein 1G, which complexes heavy metals) and endogenous antioxidants that eliminate ROS. However, UV radiation has a negative effect on Nrf2 activity, limiting its activation and thereby preventing it from fulfilling its full protective role.

Figure 1.
Diagram of Nrf2 factor activation under physiological conditions.
Oxidative stress and electrophilic compounds promote the release of Nrf2 from its natural inhibitor Keap1. Following translocation to the nucleus, it interacts with the specific ARE sequence in the DNA to activate transcription of genes encoding detoxification and antioxidant enzymes, thereby maintaining cellular homeostasis.



It is on the basis of this knowledge that NAOS developed PHOTODERM XDEFENSE ULTRA-FLUID SPF50+, a sun care product that protects the skin ecosystem through two complementary technologies:

- The ENVIRONMENTAL ACTIVE DEFENSE technology, which combines physical and biological protection: on one hand, biological protection against environment-induced DNA damage; on the other, physical protection *via* a combination of just three solar filters for SPF50+/UVA 35.9, associated with an anti-pollution glycofilm that limits the adhesion and thus the penetration of environmental pollutant particles.

DNA protection was demonstrated on human skin explants following 4 days of exposure to UVA, UVB, visible light and infrared radiation, showing a 99% reduction in thymine dimers formation — equivalent to results obtained with the non-irradiated control.

- The DETOX SCIENCE technology, which helps the skin to boost its natural detoxification mechanisms by activating the Nrf2 pathway, thereby restoring the skin's own defence capabilities. **The detoxification capacity of DETOX SCIENCE was evaluated *in vitro* on human keratinocytes, demonstrating an increase in the expression of the metallothionein 1G gene of over 164%.**

PHOTODERM XDEFENSE ULTRA-FLUID SPF50+ is available in 4 tints to enable daily use by the widest possible range of users.

— NAOS and Hyperpigmentation —

For pigmentary disorders, NAOS has developed PIGMENTBIO C-CONCENTRATE, a serum suitable for use as monotherapy or as an adjunct treatment. It is based on LUMIREVEAL technology, which mimics the mode of action of Kligman's triple combination: glabridine for its anti-inflammatory activity, Epidermactiv to stimulate cell renewal, and andrographolide and azelaic acid to reduce melanin production and storage. The serum also contains vitamin C in its ascorbyl glucoside form — inactive and therefore highly stable — which is activated on contact with the skin, along with niacinamide, glycolic acid and salicylic acid to reinforce the skin barrier, promote the elimination of dead cells and support epidermal renewal. **The efficacy of PIGMENTBIO C-CONCENTRATE as monotherapy in patients with melasma demonstrated a 50% reduction in the m-MASI score at 3 months. It may therefore be used as a maintenance treatment to prevent the recurrence of pigmentary lesions, as a relay or in combination with pharmacological treatments.**

To protect against the effects of blue light and prevent the onset or worsening of pigmentary disorders, NAOS has developed PHOTODERM M SPF50+, intended for patients with melasma. This is a high-technology sun care product offering high-level solar protection with enhanced UVA 39. PHOTODERM M SPF50+ also contains a high concentration of pigments, including iron oxide, providing 61 to 66% protection against blue light depending on the light-to-dark tints of PHOTODERM M SPF50+. **A study conducted in melasma patients with phototypes III to V, using PHOTODERM M SPF50+ daily without any depigmenting agent or parallel treatment, demonstrated a reduction in the modified Melasma Area and Severity Index (mMASI) of approximately one-third at 4.5 months.** It is the presence of pigments — notably iron oxides — filtering visible light that accounts for this effect on melasma hyperpigmentation, as the same formula without pigments does not demonstrate the same efficacy.

CONCLUSION

NAOS today offers three solutions for photoprotection and the management of hyperpigmentation. PHOTODERM XDEFENSE ULTRA-FLUID SPF50+ is aimed primarily at urban populations, offering protection against both the effects of the sun and pollution. PIGMENTBIO C-CONCENTRATE may be used as monotherapy or in combination with or as a relay to treatments for existing pigmentary disorders. Finally, PHOTODERM M SPF50+ is intended for melasma patients as both a preventive and a treatment continuity measure.

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