

# AEDV 2023 Highlights

Con el patrocinio de:



32º EDICIÓN • 32º EDICIÓN • 32º EDICIÓN • 32º EDICIÓN • 32º EDICIÓN • 32º EDICIÓN • 32º EDICIÓN • 32º EDICIÓN • 32º EDICIÓN • 32º EDICIÓN

# BER LIN

11-14 OCTUBRE

Iniciativa científica de:



ACADEMIA ESPAÑOLA  
DE DERMATOLOGÍA  
Y VENEREOLOGÍA





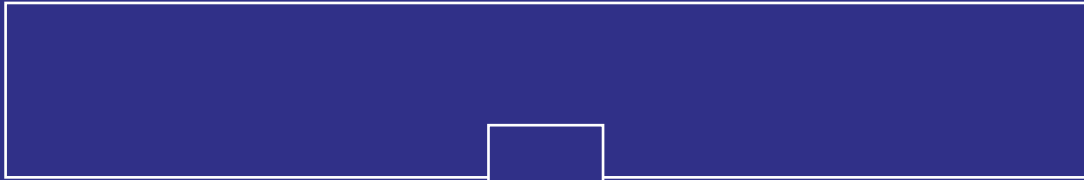
# **AEDV2023** **Highlights**

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ADVISORY AND SPEAKER FOR:



Laroche Posay  
Eucerin  
Genové  
Rilastil  
Cantabria Labs

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# BER LIN

11-14 OCTUBRE





Fotodermatosis



Fotodiagnóstico



fototerapia



Fotoprotección



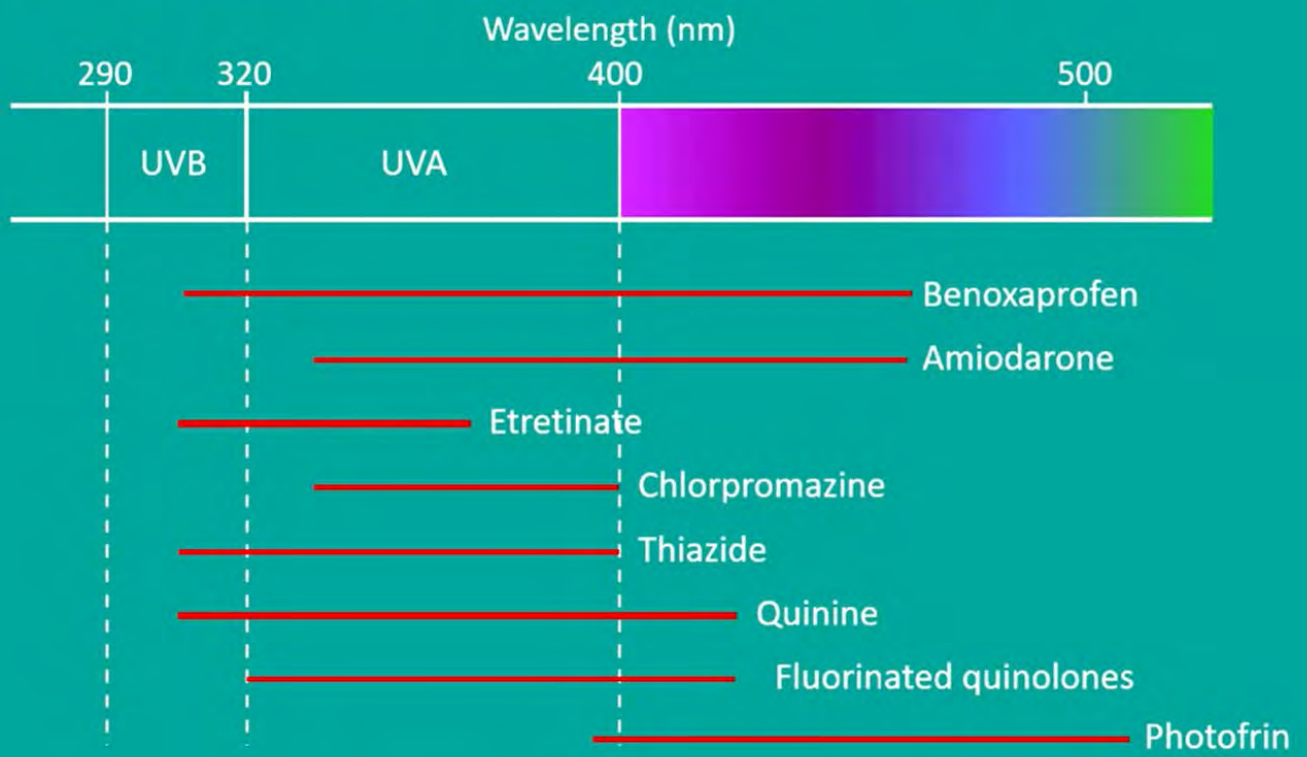
Terapia  
fotodinámica



## Fotodermatosis



# Action Spectra for Drug Phototoxicity



Most drugs absorb maximally in UVA, but some absorb also in UVB &/or visible regions – based on data derived from monochromator phototesting



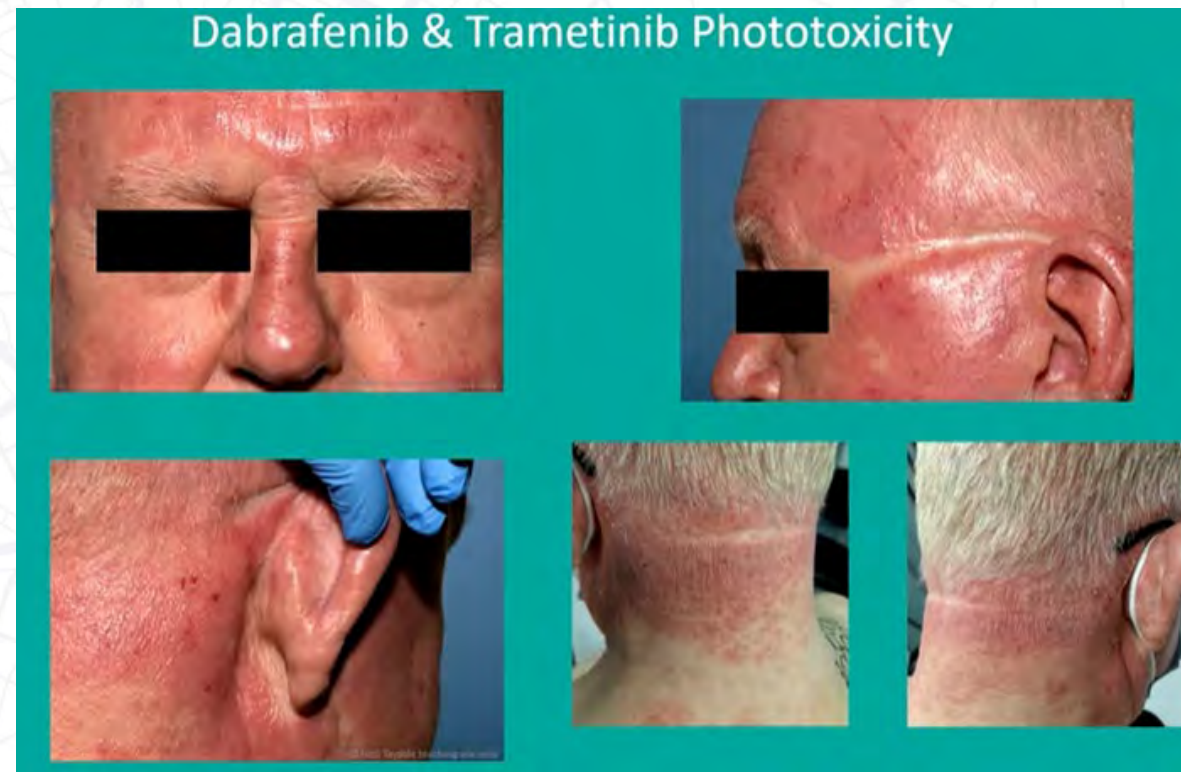
**Sally Helen Ibbotson**  
Drug-induced photosensitivity

- Antibiotics – fluoroquinolones
- Antiviral – Hep C; retroviral – reverse transcriptase, protease & polymerase inhibitors
- Anti-cancer drugs – BRAF, EGFR, Tyr Kinase Inhibitors
- Biologics – anti-TNF, denosumab
- Porphyrins – systemic PDT
- Azathioprine
- Proton pump inhibitors
- Pirfenidone
- Levetiracetam

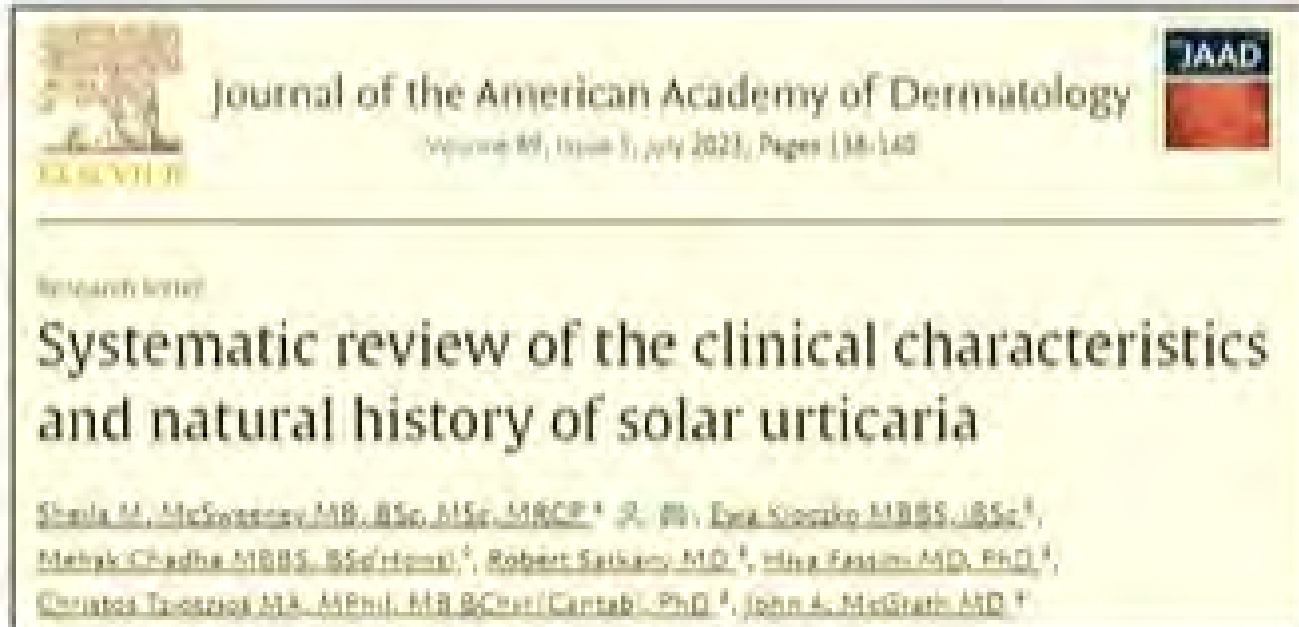


Kim *et al.*, *J Am Acad Dermatol* 2018; Ibbotson *PPS* 2018; Blakely *et al.*, *Drug Saf* 2019 ;  
Alrashidi *et al.*, *PPP* 2020; Bonino *et al.*, *PPP* 2023









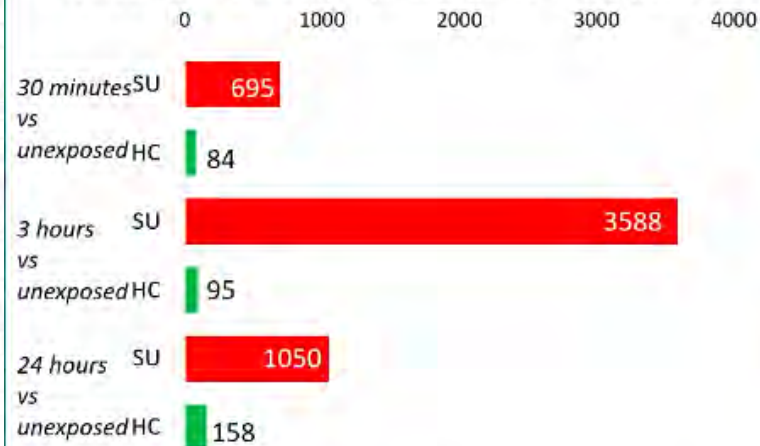
**n=854 cases from 12 countries:**  
Thailand, Israel, France, Japan, UK, Germany,  
Italy, Singapore, USA, Spain, Australia, Belgium





## DIFERENCIAS EN EXPRESIÓN DE GENES ENTRE PIEL NORMAL Y CON URTICARIA SOLAR

Number of differentially expressed genes vs unexposed skin



Paired comparison vs baseline  
Filters: log2fold change >1 or <-1; adjusted p value (q value) < 0.05

Number of differentially expressed genes: solar urticaria vs healthy skin at each timepoint

	Solar urticaria vs Healthy control		
	Total	Upregulated	Downregulated
Baseline	149	10	139
30 minutes	406	213	193
3 hours	3244	1711	1533
24 hours	674	370	304

### RNASeq Analysis using Qiagen Ingenuity Pathway Analysis (IPA)

- Molecular pathways
- Upstream analysis
- Disease/function associations
- Individual molecules/transcripts

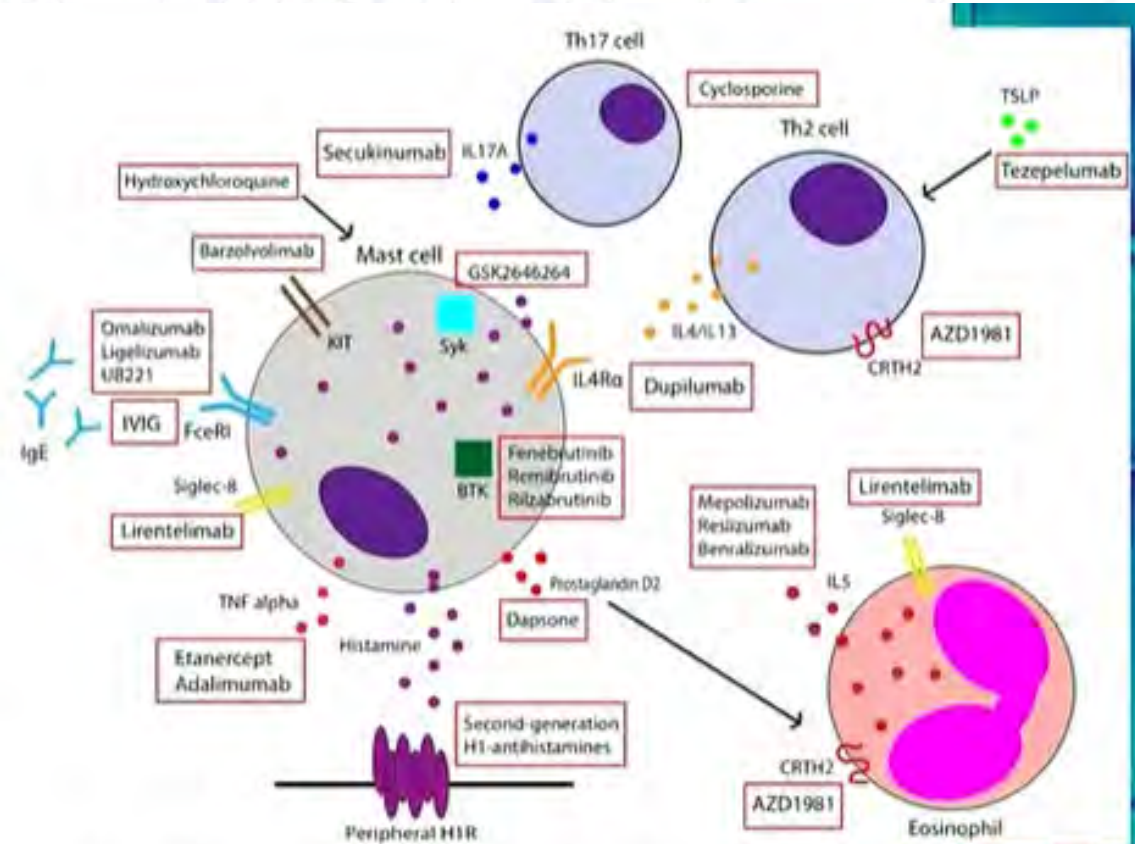


Upstream Regulator	Expr Log Ratio	Molecule Type	Activation z-score
TNF	0.873	cytokine	7.9
IL1B	4.682	cytokine	7.5
NFkB (complex)		complex	6.9
IFNG	0.334	cytokine	6.6
PDGF BB		complex	6.4
EGF	0.400	growth factor	5.7
CREB1	-0.215	transcription regulator	5.6
CSF2	2.976	cytokine	5.5
IL2	2.956	cytokine	5.5
IL1A	0.912	cytokine	5.5
OSM	4.901	cytokine	5.5
MYD88	0.330	other	5.3
VEGF		group	5.3
STAT3	0.298	transcription regulator	5.2
TLR3	-0.040	receptor	5.1
ERK		group	5.1
IL6	6.075	cytokine	5.1
Leukotriene D4		endogenous chemical	5.1
TLR7	-0.462	receptor	4.9
IgE		complex	4.9
FceR1		complex	3.5



## • Potential emerging therapies

- Inhibition of mast cell activation
  - BTK inhibition eg oral remibrutinib
    - Reported benefit in CSU
  - Other potential targets eg MRGPRX2, TSLP, C5a inhibition
- Mast cell silencing
  - Anti-Siglec8 agent eg lirentelimab
    - Open label trial included cholinergic urticaria & symptomatic dermographism
- Mast cell depletion
  - Anti-KIT antibody eg barzolvolimab
    - Open label study included cold urticaria & symptomatic dermographism
- Potential for other mast cell receptor directed therapies



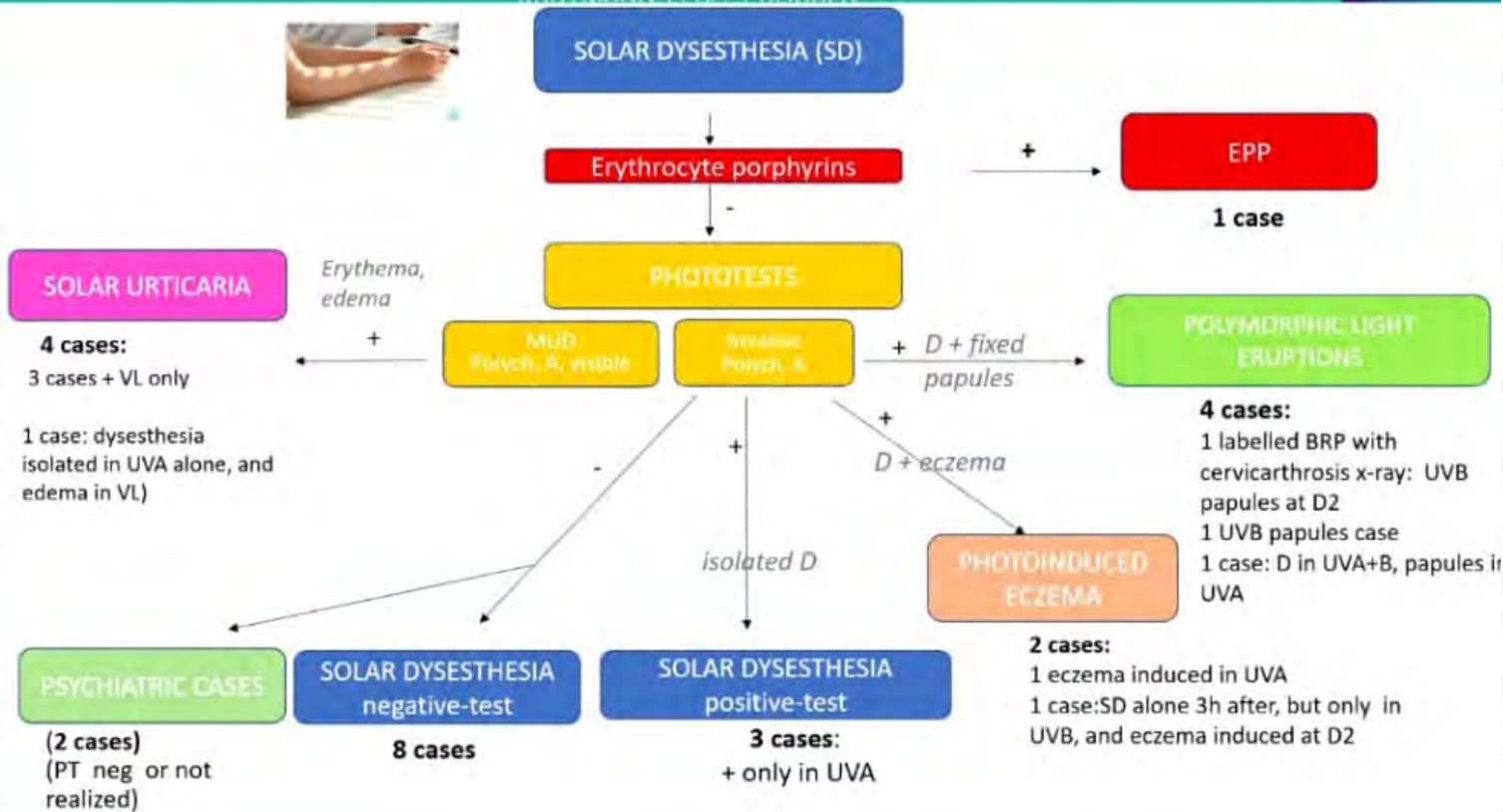
From Yosipovitch, Dermatol Ther 2023:1647–1660





## Fotodiagnóstico





## Sunlight-induced Painful Skin (Sun Pain): A New Differential Diagnosis in Photodermatology

Piergiacomo CALZAVARA-PINTON<sup>1</sup>, Marina VENTURINI<sup>1</sup>, Chiara ROVATI<sup>1</sup>, Mariachiara ARISI<sup>1</sup>, Irene CALZAVARA-PINTON<sup>1</sup>, Fabrizio RINALDI<sup>2</sup> and Maria Teresa ROSSI<sup>1</sup>  
<sup>1</sup>Dermatology Department, ASST Spedali Civili di Brescia, University of Brescia, Brescia, and <sup>2</sup>Department of Neurology, Franz Tappeiner Hospital, Merano, BZ, Italy



# CONCLUSIONES

- Mas que una enfermedad es un síntoma debido a exposición solar
- No relacionada con desórdenes neurológicos
- Pero puede ser precursor clínico de otras fotodermatosis
- Acompañar de porfirinas y fototest para guiar la fotodiagnos





## Fotoprotección



## New sunscreens

Yolanda Gilaberte  
Department of Dermatology  
Miguel Servet University Hospital  
Zaragoza  
Spain

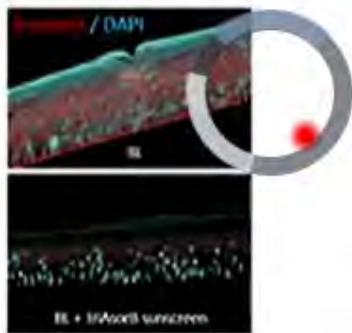
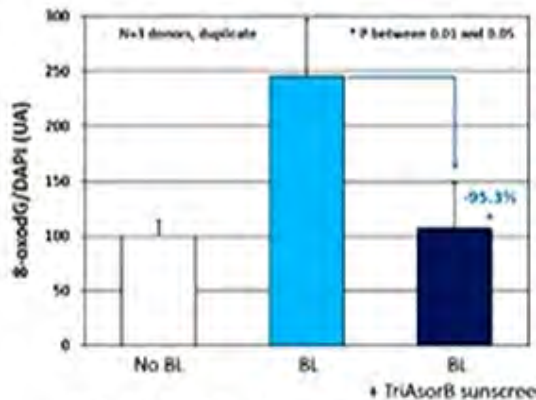


**Yolanda Gilaberte  
Calzada**  
New sunscreens



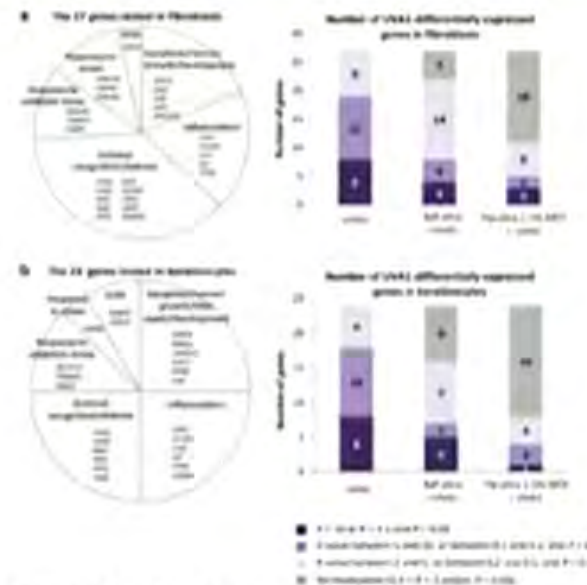
## Phenylene Bis-Diphenyltriazine (TriAsorB), a new sunfilter protecting the skin against both UVB + UVA and blue light radiations

D. Bacqueville<sup>1,4</sup> · C. Jacques-Jamin<sup>1</sup> · H. Dromigny<sup>1</sup> · F. Boyer<sup>1</sup> · Y. Brunel<sup>1</sup> · P. J. Ferret<sup>1</sup> · D. Redoules<sup>2</sup> · T. Douki<sup>1</sup> · S. Bessou-Touya<sup>1</sup> · H. Duplan<sup>1</sup>



### HEV/Blue light at 427 nm at 80 J/cm<sup>2</sup> irradiation in reconstructed human epidermis

## METHOXYPROPYLAMINO CYCLOHEXANIDE ETHOXYETHYLGLYCANOACETATE (MCE) Gen expression analysis of 3D skin models exposed to UVA1



### SUMMARY

The addition of the MCE filter in a state-of-the-art formula INCREASE THE PROTECTION against the cellular, biochemical and molecular changes induced by UVA1 in reconstructed human skin

et C, et al. JID Innovations 2022;2:100070

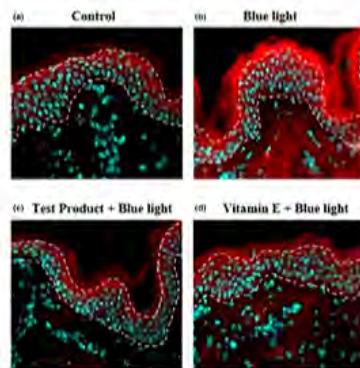
### BDBP (Bis-Diethylaminohydroxybenzoyl benzoyl) piperazine Pigmentation photoprotection study

THE FORMULA CONTAINING BDBP SHOWED A COMPLETE PROTECTION FOR BOTH SPECTRA AT ALL TIME POINTS AND DOSES TESTED

	385nm			405nm		
	0 Hour	6 Hour	24 Hour	0 Hour	6 Hour	24 Hour
1 J/cm <sup>2</sup>	NT V A B	NT V A B	NT V A B	NT V A B	NT V A B	NT V A B
10 J/cm <sup>2</sup>	NT V A B	NT V A B	NT V A B	NT V A B	NT V A B	NT V A B
50 J/cm <sup>2</sup>	NT V A B	NT V A B	NT V A B	NT V A B	NT V A B	NT V A B

Sunscreen A: Uninul A plus, Eusolex 232, Uninul T150  
 Sunscreen B: Same filters + BDBP

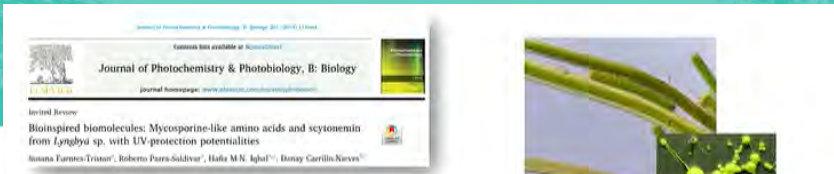
### Effect on oxidized proteins



82% protection      66% protection

- TDF® Blue Voile Sunscreen
- Blue blocking agent: Polymethylsilsesquioxane (PMSQ) and HDI/Trimethylol hexyllactone crosspolymer 1%
  - Good thermal and chemical stability
  - Good biocompatibility
  - Non-toxicity
  - Made the formula more cosmetic
- Ex vivo in skin explants exposed to 460 nm (14 J/cm<sup>2</sup>) of blue light to evaluate prevention of oxidation parameters
- In vivo (39 subjects phototype IV and VI) were exposed to blue light 415 nm (60 J/cm<sup>2</sup>) to evaluate prevention of hyperpigmentation





## Scytonemin

- A highly stable, yellow-brown, lipid-soluble inducible pigment in cyanobacteria
- Synthesis is induced by **UVAR** whose entry to the cell
- Absorption maximum at **386 nm**, with a wide UV range (from 212 to 386 nm)



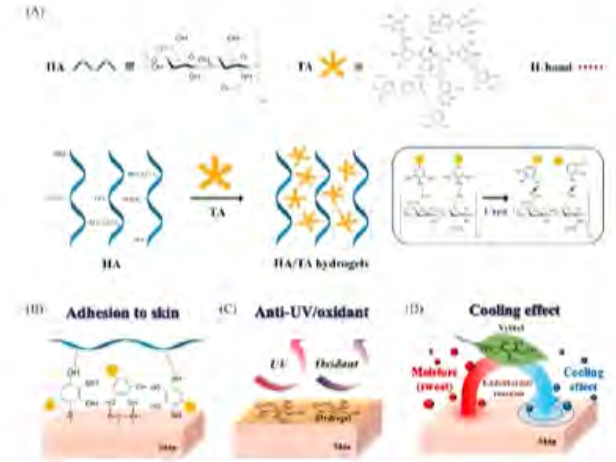
## Review Mycosporine-Like Amino Acids (MAAs): Biology, Chemistry and Identification Features

Vanessa Geraldes <sup>1,2</sup> and Ernani Pinto <sup>2,\*</sup>

- <sup>1</sup> School of Pharmaceutical Sciences, University of São Paulo, Avenida Prof. Lineu Prestes, 580, Butantã, São Paulo-SP CEP 05508-000, Brazil; vanessa.geraldes@usp.br
  - <sup>2</sup> Centre for Nuclear Energy in Agriculture, University of São Paulo, Piracicaba, Piracicaba-SP CEP 13400-970, Brazil
- \* Correspondence: emani@usp.br

## Cooling sunscreens

- Hydrogels with a 3D network structure and high water content
- Hyaluronic acid and tannic acid
- **Polyols (xylitol)**
- Broad UV spectrum protection (280-360 nm)
- Decrease skin temperature by 6.6 °C after 5 minutes for long duration
- Effects:
  - Skin hydration
  - Cooling effect
  - Antioxidant activity



ak MA, et al. Int J Biol Macromol 2021;191:918-924

EA CONGRESS  
DV

ACS Appl Mater Interfaces. 2023 Mar 15;15(10):10383-10397. doi: 10.1021/acsami.2c19773. Epub 2023 Feb 17.

**A Bioinspired Skin UV Filter with Broadband UV Protection, Photostability, and Resistance to Oxidative Damage**

Nini Li <sup>1</sup>, Xiaohong Ji <sup>2</sup>, Zhenzhen Ma <sup>1</sup>, Bing Yang <sup>1</sup>, Yinyan Ren <sup>1</sup>, Changshu Wang <sup>1</sup>, Yashao Chen <sup>1</sup>

## Biomimetic sunscreens

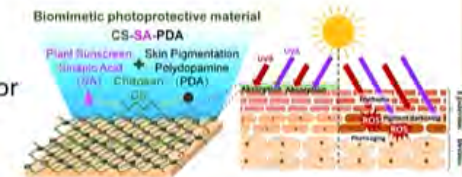
Bionic photoprotective material CS-SA-PDA nanosheet

### Components:

- Natural melanin analogue polydopamine (PDA) nanoparticles
- Plant sunscreen molecular sinapic acid (SA) as sun protection factor
- Natural polymer chitosan (CS)

### Results

- Shield UVB and UVA (effect of PDA and SA)
- Polymer CS improved the photostability of SA and reduced the skin permeability of PDA nanoparticles
- The CS-SA-PDA nanosheet can also scavenge photoinduced free radicals
- No skin irritation





Skin bioadhesive UV filters: a radical innovation in sun protection

*Bertrand J., Ainié L., Séjourné N., Makrrougras M., Carniato D., Rault I.*





## Discussion



**Liezel Griffin**

The impact of afamelanotide on UVR-induced DNA damage and repair in healthy human skin of phototypes II-III

Short-term afamelanotide reduces UVR-induced DNA damage in healthy individuals

The mechanism is currently unclear but could be contributed to by:

- Photoprotection by early tanning
- Priming of DNA damage repair system and/or anti-oxidant effects, possibly enhancing repair within the 15 minutes prior to biopsy
- The impact of afamelanotide could be further explored in DNA damage disorders

### Next steps:

- RNA sequencing analysis to explore anti-oxidant properties and potential anti-inflammatory effects
- Immunohistochemical investigation of other markers of DNA damage repair – p53, γH2AX, XP molecules



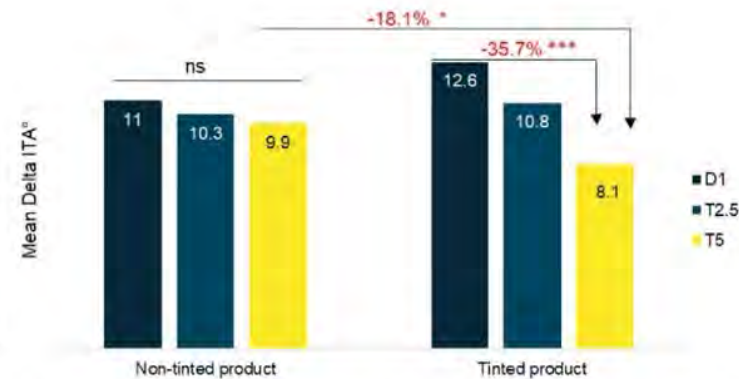
## A RANDOMIZED COMPARATIVE STUDY ON MELASMA DURING SUMMER WITH A VISIBLE LIGHT-PROTECTED TINTED SUNSCREEN VERSUS A STANDARD NON-TINTED SUNSCREEN

Polena H.<sup>1</sup>, Queille-Roussel C.<sup>2</sup>, Chavagnac M.<sup>1,3</sup>, Graizeau C.<sup>1,3</sup>, Duteil L.<sup>2</sup>, Passeron T.<sup>4,5</sup>, Sayag M.<sup>1</sup>

<sup>1</sup>NAOS Group, Research and Development Department, Aix-en-Provence, France; <sup>2</sup>Center of Clinical Pharmacology Applied to Dermatology (CPCAD), L'Archet 2 Hospital, Nice, France; <sup>3</sup>NAOS Institute of Life Science, Aix-en-Provence, France; <sup>4</sup>Department of Dermatology, Centre Hospitalier Universitaire de Nice, University Côte d'Azur, Nice, France; <sup>5</sup>C3M, INSERM U1065, University Côte d'Azur, Nice, France



**Figure 1:** The application of the tinted sunscreen showed a significant reduction in the mMASI score of **12.5%\*\*\*** (3.5 vs. 4 at D1) after 5 months. No significant differences were however observed between the two products.



**Figure 2:** Mean of  $\Delta ITA^\circ$  (skin pigmentation): difference between melasma and the surrounding area showed a **significant improvement** in the tinted sunscreen group when compared to the non tinted group and when compared to day 1.

Fig bet shc sur gro



## *In vivo* evaluation of sunscreen application by multispectral imaging: A new tool for educating sunscreen users

J. Le Digabel, E. Questel, C. Lauze, G. Josse; R&D, Pierre Fabre Dermo-Cosmétique et Personal Care, Toulouse, France

F. Carballido; Medical Direction, Laboratoire Dermatologique Végétal A-DERMA, Lavour, France

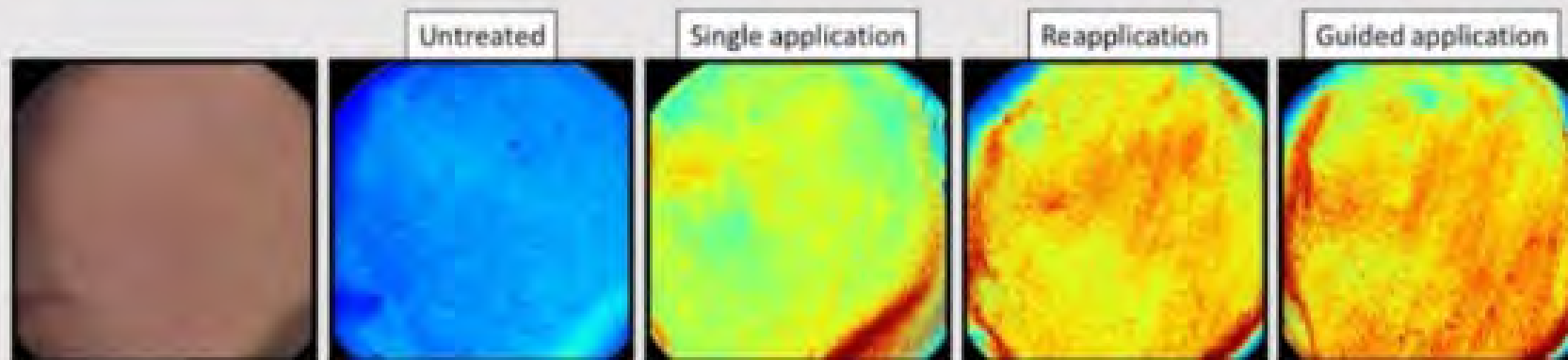


Fig. 1: Representative heatmap images showing spreading of the sunscreen by one typical volunteer for the different application modalities





## Fototerapia

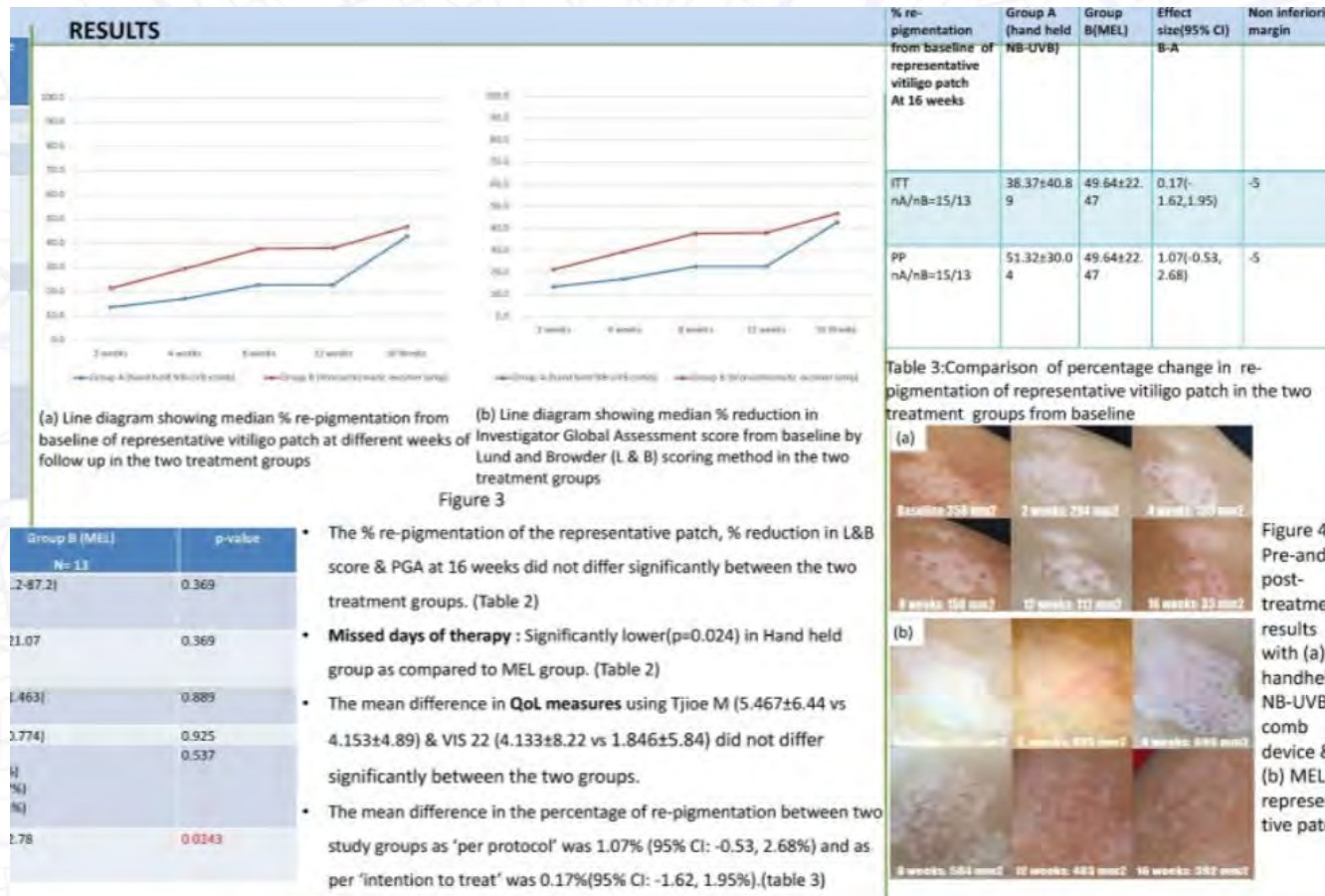


# Fototerapia en casa similar a la hospitalaria

EADV Congress 2023, Berlin

An open label non-randomized preliminary study comparing two targeted phototherapy devices i.e. daily use of home-based hand-held Narrow Band UVB comb device versus biweekly hospital-based excimer light therapy in treatment of localized vitiligo

Iftexhar Khan<sup>1</sup>, Sujay Khandpur<sup>1</sup>, VK Sharma<sup>1</sup>, BK Khaitan<sup>1</sup>, Neetu Bhari<sup>1</sup>, RM Pandey<sup>2</sup>  
Department of Dermatology & Venereology<sup>1</sup>, Biostatistics<sup>2</sup> AIIMS, New Delhi







## Terapia fotodinámica



## New approaches on PDT in Dermatology



Biomarkers to predict the response of PDT for skin cancer



New possible indications: antimicrobial PDT



Digital devices to assist PDT



**Yolanda Gilaberte**

New approaches on PDT in Dermatology

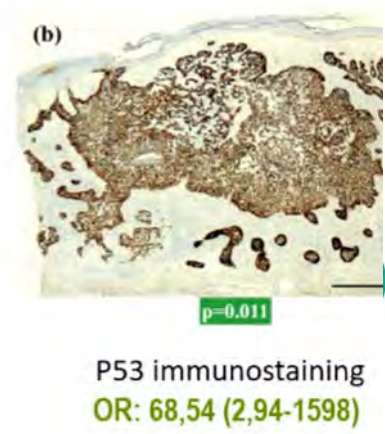
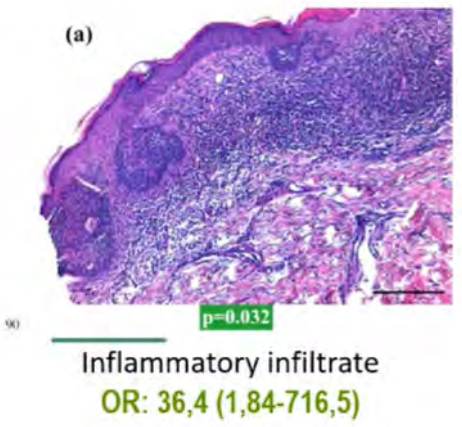
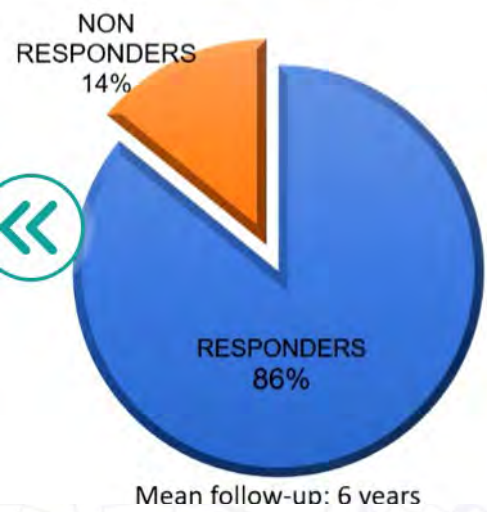


RESEARCH ARTICLE  
 Biomarkers of basal cell carcinoma resistance to methyl-aminolevulinat photodynamic therapy

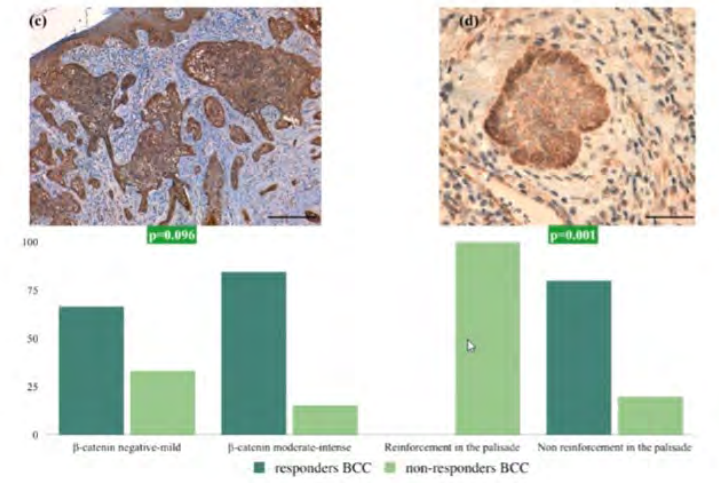
Tamara Gracia-Cazalla<sup>1,2</sup>, María Mascarque<sup>3</sup>, Silvia Rocio Lucena<sup>4</sup>, Jesús Vera-Arriaga<sup>5</sup>, Salvador González<sup>1</sup>, Angeles Juarrero<sup>1</sup>, Yolanda Gilaberto<sup>1</sup>

<sup>1</sup> Department of Dermatology Hospital de Basaloides, Murcia, Spain, <sup>2</sup> Department of Biology, Universidad Autónoma de Madrid, Madrid, Spain, <sup>3</sup> Pathology Service, Hospital San Jorge, Huelva, Spain, <sup>4</sup> Department of Medicine and Medical Specialties, University of Alcala, Alcala de Henares, Madrid, Spain, <sup>5</sup> Dermatology Service, Hospital Miguel Servet, Zaragoza, Spain

- 390 BCC in 182 patients
- 7 clinical variables
- 9 histological variables
- 7 immunohistochemical variables



## $\beta$ -catenin immunohistochemical expression statistically associated with the response



## Multivariate analysis to predict BCC response to PDT

Variables	Odds Ratio (CI 95%)	P
Age <63 years	1,3 (1,07-1,57)	0,006
BCC nodular	0,02 (0,0-0,53)	0,029
Presence of inflammatory infiltrate	36,4 (1,84-716,5)	0,018
Immunostaining positive P53	68,54 (2,94-1598)	0,009

- **P53:**
  - POSITIVE in 90% of BW with complete response
  - Positive in 30% of non-responders ( $p=0,01$ )
- **Cycline D1:**
  - Positive en 33% de responders
  - POSITIVE in 80% of non-responders ( $p=0.023$ )
- **EGFR:**
  - Intense staining in 60% of non-responders
  - Intense staining in 14% of non-responders ( $p=0.015$ )

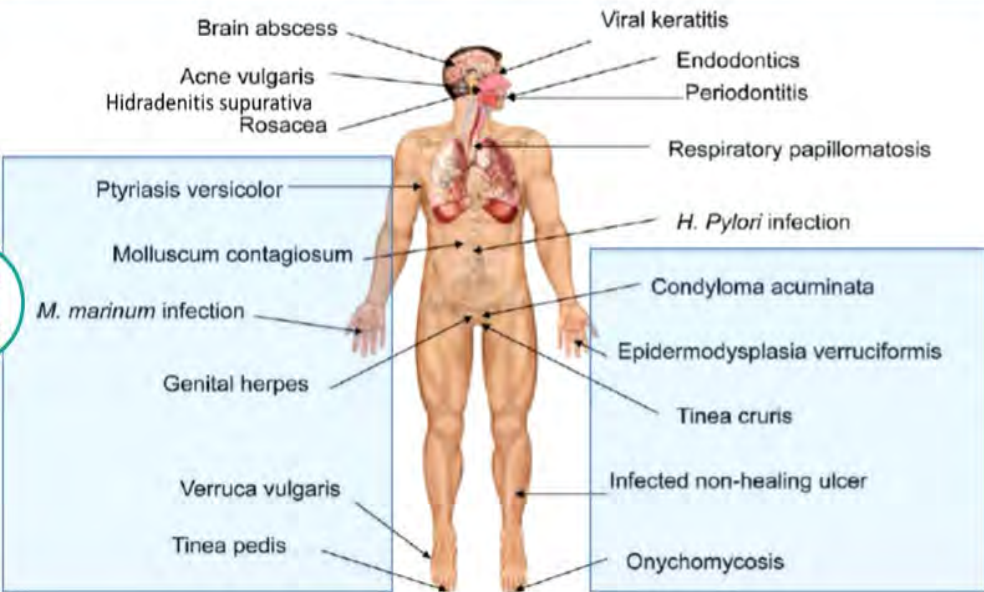
P5:



G Ital Dermatol Venereol. 2018 Dec;153(6):833-846. doi: 10.23736/S0392-0488.18.06007-8. Epub 2018 Apr 19.

## Antimicrobial effects of photodynamic therapy.

Pérez-Laguna V<sup>1,2</sup>, García-Malinis AJ<sup>3</sup>, Aspiroz C<sup>4</sup>, Rezusta A<sup>1,5</sup>, Gilaberte V<sup>6,7</sup>.



> Photochem Photobiol Sci. 2019 May 15;18(5):1020-1029. doi: 10.1039/c8pp00534f.

## A combination of photodynamic therapy and antimicrobial compounds to treat skin and mucosal infections: a systematic review

Vanessa Pérez-Laguna <sup>1</sup>, Yolanda Gilaberte, María Isabel Millán-Lou, Montserrat Agut, Santi Nonell, Antonio Rezusta, Michael R Hamblin

- The best aPDT combinations involved 5-ALA or phenothiazinium PS
- In general, the COMBINATION SHOWS BENEFITS:
  - Reducing treatment times
  - Lowering drug dosages
  - Decreasing drug toxicity
  - Improving patient compliance
  - Diminishing the risk of developing resistance
- The **mechanism of action** may be that first aPDT damages the microbial cell wall or membrane, which allows better penetration of the antimicrobial drug



> Pharmaceuticals (Basel). 2022 Jun 7;15(6):722. doi: 10.3390/ph15060722.

### Combination of Photodynamic Therapy and Oral Antifungals for the Treatment of Onychomycosis

Alba Navarro-Bielsa <sup>1</sup>, Tamara Gracia-Cazaña <sup>1</sup>, Pilar Robres <sup>2</sup>, Concepción Lopez <sup>1</sup>, María Dolores Calvo-Priego <sup>1</sup>, Carmen Aspiroz <sup>3</sup>, Yolanda Gilaberte <sup>1</sup>

- 20 patients with recalcitrant onychomycoses
- 55% *T. rubrum*
- 90% toenail
- 50% associated *tinea pedis*
- **Combination with oral terbinafine (3 cases only topical)**
- **RESULTS:**
  - 80% complete clinical response
  - 60% microbiological response



	N (%)
<i>T. rubrum</i>	11 (55)
<i>A. terreus</i>	3 (15)
<i>T. mentagrophytes</i>	2 (10)
<i>A. sydowii</i>	2 (10)
<i>A. fumigatus</i>	1 (5)
<i>F. oxysporum</i>	1 (5)

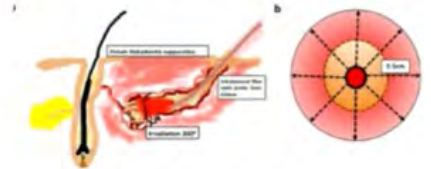
Br J Dermatol. 2015 Apr;172(4):1136-9. doi: 10.1111/bjd.13385. Epub 2015 Feb 25.

### Treatment of hidradenitis suppurativa with intralesional photodynamic therapy using a laser diode attached to an optical cable: a promising new approach.

Valladares-Narganes LM<sup>1</sup>, Rodríguez-Prieto MA, Blanco-Suárez MD, Rodríguez-Lage C, García-Doval J.



Courtesy Dr. MA Rodríguez-Prieto



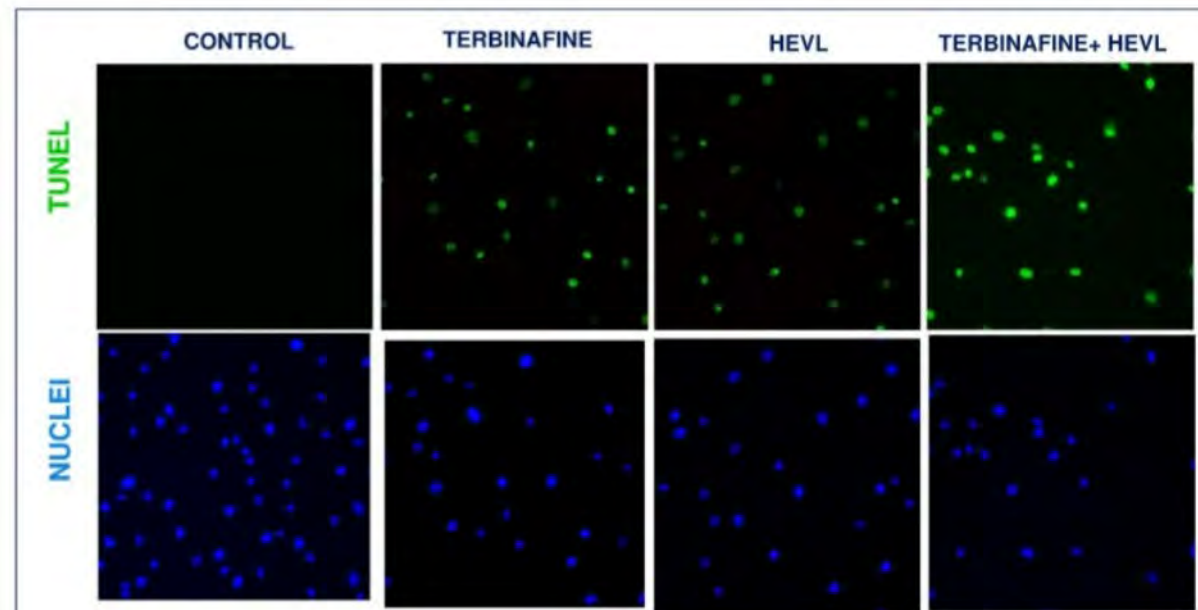
Laser light 630nm → 2,4 cm  
Effective therapeutic respuesta → 1 cm



**SYNERGIC EFFECT OF HIGH ENERGY VISIBLE LIGHT BIOMODULATION AND TERBINAFINE IN REACTIVE OXYGEN SPIECES PRODUCTION ON HUMAN KERATINOCYTES**

Luis Alfonso Pérez González<sup>1,2</sup>, María Antonia Martínez Pascual<sup>2</sup>, Elena Toledano Macías<sup>2</sup>, Montserrat Fernández Guarino<sup>1</sup>, María Luisa Hernández Bule<sup>2</sup>

1. Hospital Universitario Ramón y Cajal. Servicio de Dermatología (1) and Instituto Ramón y Cajal de Investigación Sanitaria (IRyCIS).Laboratorio de Fotoelectromagnetismo.(2)



**Figure 2:** TUNEL assay shows increased apoptosis in both terbinafine and HEVL groups. Terbinafine + HEVL group shows the greatest number of apoptotic cells with a cellular viability under 50% compared to controls. The quantification of cell nuclei (DAPI) shows a decreased cellular viability in all groups compared to controls.



# Usefulness of the SmartPDT® digital medical device to optimise the effectiveness and safety of natural daylight PDT (NDL-PDT): a clinical study in Spain

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## Smart PDT



### Web site

- Doctors and nurses
- Inclusion of patients
- To define session parameters
- To include medical photographs
- Follow-up of the patient in real time
- Privacy and security of data

### App

- Patients
- IOS and Android
- Instructions
- Questionnaire after PDT sesión
- Send photographs in real time





# Fotoprotección=detección UV total vía satélite



## Field validation of a satellite-based dosimeter of personal solar exposure



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### Abstract

- Solar radiation has an important impact on human health and wellbeing, with both harmful and beneficial effects. Accurately monitoring personal solar exposure in real-time could be highly beneficial for personal day-to-day health and for photobiological studies that deepen our understanding of the impact of the sun on our health.
- A field test of a global satellite-based digital solution for personal solar exposure dosimetry ("ExpoDose" by siHealth Ltd, UK) has been conducted
- ExpoDose, installed on a smartphone, is shown to be comparable in accuracy to wearable dosimeters. Wearable instruments are more expensive, hard to maintain, hard to scale and suffer from low compliance by participants. Remote monitoring can address these issues. Solar dose is measured remotely with 1 minute resolution for any number of users, multiple action spectra and multiple body sites (planes) simultaneously.
- Automatic outdoor detection using smartphone sensors allows long-term automated tracking of personal solar exposure.



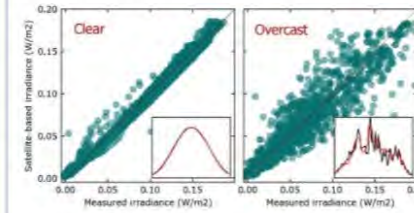
Examples of acute and chronic sun damage

### Field validation study

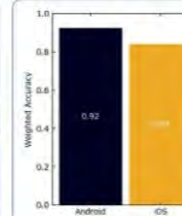
- Solar dose validation using sensors on 8 tilted planes and a reference radiometer in the horizontal plane
- Spring and Summer in Italy (Brescia) and the UK (Oxfordshire)
- >130 days measurement. 4 different zenith angles. 8 compass points (see photo).
- UV-erythmal calibrated radiometer (Kipp & Zonen, Netherlands). Horizontal plane in the same location.



Above: Image of the "Iron-flower" structure used to orient the dosimeters on 10 different planes.



- Days with clear sky show excellent agreement ( $R^2=0.978$ , MAE=4.1%)
- Days with overcast sky show good agreement ( $R^2=0.855$ , MAE=20.2%)
- Irradiance match to satellite-model shown on inserts for example clear and overcast day

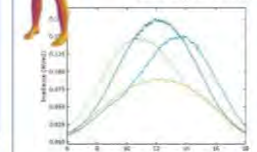


### AI-assisted automatic indoor-outdoor detection technology

- Smartphones are an ideal technology for outdoor tracking as they contain a range of sensors and are regularly carried on the person during the day.
- ML model with sensors input: GPS, network signal strength, motion sensing and the light sensor
- Validation of the model was carried out on 20 different models of phones (both Android and iOS) in two countries. Weighted detection accuracy overall was found to be 88%.

### Dosimetry on different body planes

- Dose up to 100% different on different parts of the body
- Some areas are more vulnerable to acute and chronic sun damage. Important to take body location into account.
- Tilted plane correlation excellent, accuracy good. Overall  $R^2=0.898$ , MAE=24.8%. Both in the UK and Italy. Tilted plane biases will be further investigated.
- Accuracy consistent in both Brescia and Oxford locations



Direction	R <sup>2</sup>	MAE	MBE
Horizontal plane (0 tilt)	0.949	9.1%	1.1%
North (45 tilt)	0.928	9.6%	-3.1%
East (45 tilt)	0.893	22.8%	8.7%
South (45 tilt)	0.929	23.3%	19.3%
West (45 tilt)	0.894	21.8%	6.7%

Above: N, E, S, W plane measurements (45° tilt) for an example clear day. Expected asymmetry for E and W plane is evident.



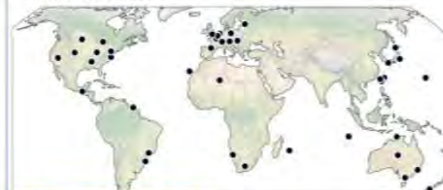
- ExpoDose app and web portal.
- Monitor personal exposure for photobiological studies, preventing skin cancer, exposure for solar phototherapy
- Uses siHealth's "HappySun" satellite technology ([www.happysun.co.uk](http://www.happysun.co.uk) Patents no. WO/2017/153832, WO/2022/136936)
- Monitors spectral solar irradiance at surface globally in near real-time
- Technology has previously been validated in projects and clinical studies with UK Health Security Agency, European Space Agency, UK National Health Service (NHS), King's College London and Medicin Clinical Research Center [1, 2, 3, 4]

1. Morelli M et al. (2016) *Photoch. Photobio. Sci.* 15(9), 1170-1175
2. Morelli M et al. (2021) *J. Atmos. Sol-Terr. Phys.* 215, 105529
3. McLellan L et al. (2020) *Photodiagn. Photodyn.* 31, 101914
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Smartphone sensor based automatic outdoor detection

### Global validation



Location	R <sup>2</sup>	MAE
Europe	0.93	14%
N. America	0.88	26%
Australia & NZ	0.83	21%
E. Asia	0.92	16%

Global intercomparison of satellite-based model with long-term ground station measurements

### Conclusion

- The ExpoDose digital solution can be effectively used for live monitoring of personal solar dosimetry. This has applications in health & wellbeing (e.g. precision photodermatology, daylight phototherapy, sun protection), along with photobiological and clinical research.
- Replaces the need for costly and time-consuming physical dosimeters (e.g. wearable dosimeters, plastic films).
- Satellite-based technology allows an accurate solar doses assessment for any combination of action spectra and spectral filters (e.g. sunscreens) updated in near real-time thanks to LEO & GEO satellite data
- ExpoDose accuracy:  $R^2 = 0.949$  & MAE = 9.1% average for horizontal plane validation (5min doses).  $R^2 = 0.898$  & MAE = 24.8% for tilted planes validated in UK and Italy.
- The ExpoDose satellite-based technology enables a reliable and easy-to-use solution for personal solar exposure assessment, suitable also for non-experts in everyday life via smartphone only (no additional hardware devices required)



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