

PEPHA[®]-AGE

*The power of microalgae
for blue light & UV defense*

CB



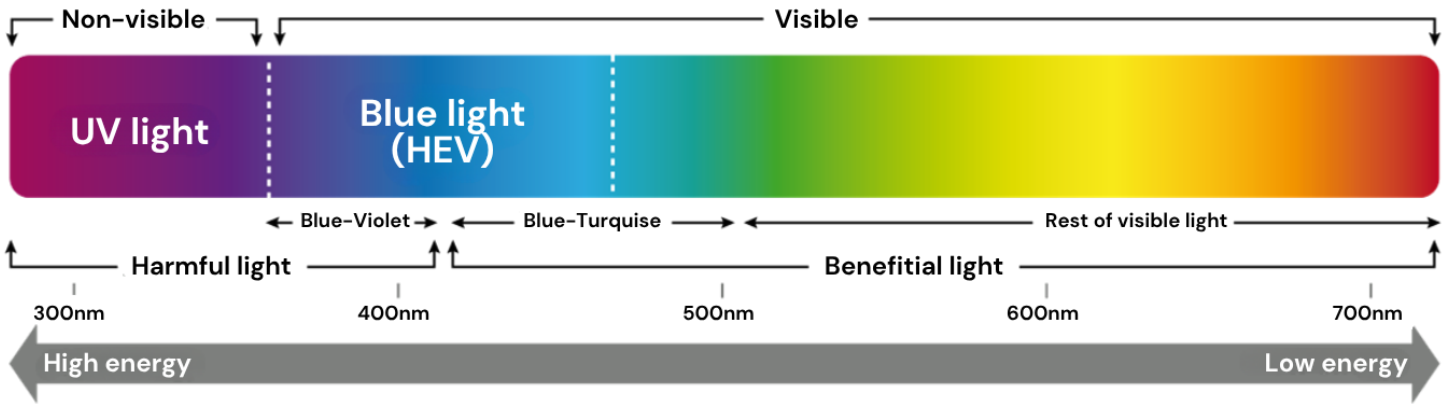
June 2025

Biotech | Nature, enhanced by science

dsm-firmenich 

We're exposed to different forms of blue light every day...

25–30% of solar radiation reaching the earth's surface is blue light



Source of blue light high energy visible (HEV 400 – 500NM)

Natural light

25–30% blue light emission

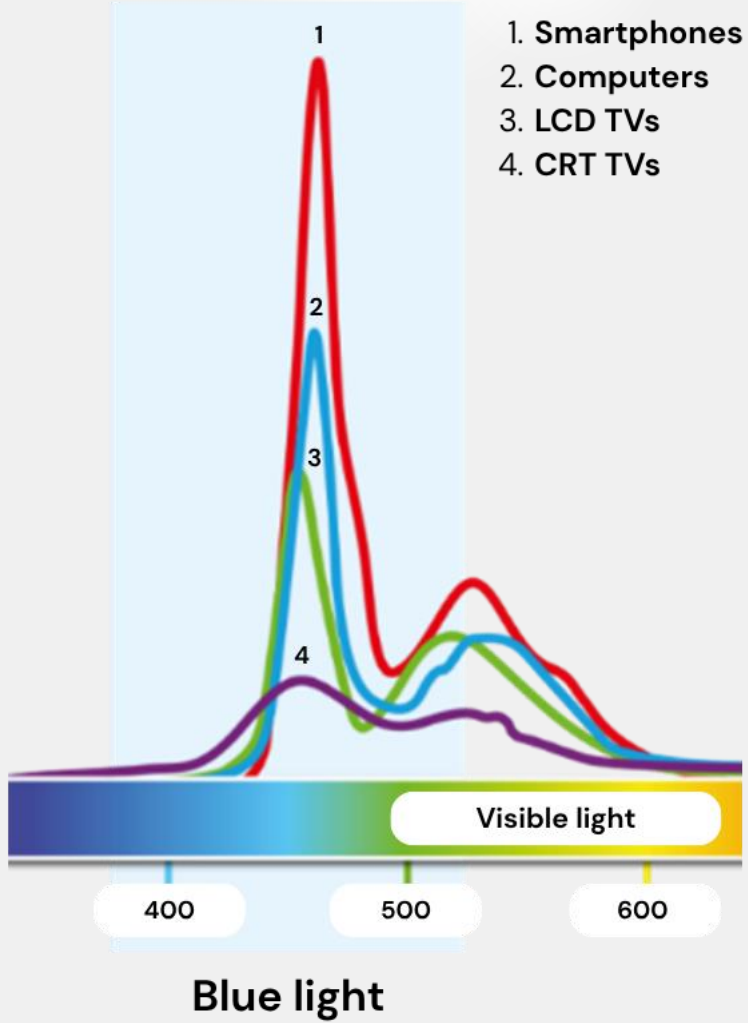
Artificial light LED

35% blue light emission

Digital devices

35% blue light emission

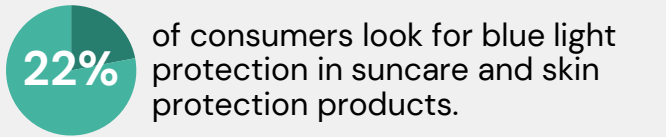
Indirect sun (Blue light 17mW/cm2) is about 100-fold more intense than electronic devices



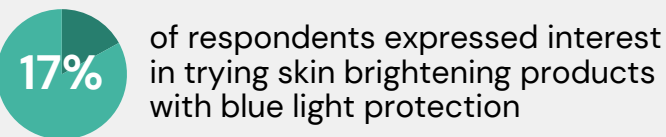
Blue light protection

A need for skin protection against environmental and digital stressors

In the US*



In India**



A growing consumer demand

There is a growing consumer interest in products with blue light protection.

Many skincare products are now incorporating blue light protection as a key feature. These products often combine protection against blue light with other benefits such as UV protection, anti-pollution, and anti-aging.

Upgraded protection

Suncare products upgrade their protection.

For example, Dr.Ci: Labo Mild UV For Sensitive Skin SPF30 PA+++ combines 4 efficient protection features for the skin from:

- **Blue light** emitted by screens
- **UVA** to prevent spots, signs of aging and wrinkles
- **UVB** to keep from getting tanned or sunburnt
- Damages caused by **near-infrared radiation**.

Beauty devices

Devices like LED light therapy are being used to manage skin tone and protect against blue light.

These devices are perceived as effective and safe, offering a trendy solution for skin tone concerns

* Mintel: Suncare and Skin Protection – US – 2025 – Topline Questions – Mintel 1,545 internet users aged 18+ who use sunscreen, or beauty or personal care products with SPF

** Mintel: Skintone Management – Indian Consumer – 2024 – Topline Questions – Mintel 2,569 Indian adults aged 18+ who have skin tone aspiration

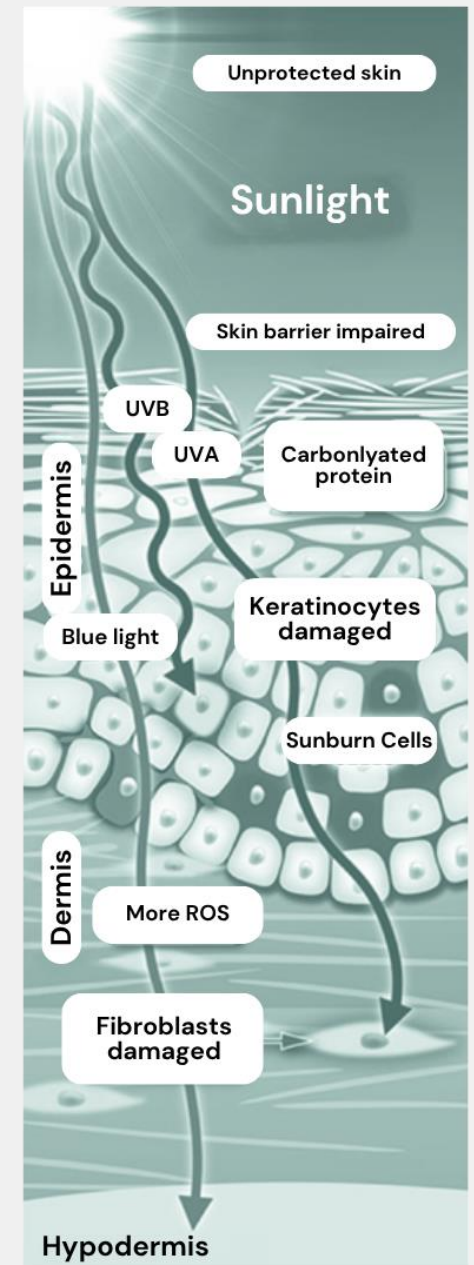
Blue light contributes to aging

Blue light penetrates deep into the skin, contributing to short- and long-term skin aging

- **Skin hyper-pigmentation** and dark spots
- **Premature aging of skin** induced by oxidative stress
 - increasing level of **free radicals** (Reactive Oxygen Species)
 - generates **carbonylated proteins**, proteins losing their functionality (responsible for yellowish, brownish color)
- **Less production of collagen**: the fibroblasts are damaged, losing their functionality in turn leading to accelerated aging (UVA adverse effect)
- **Skin barrier impaired**: the **keratinocytes** are damaged, increasing number of **sunburn cells** (UVB adverse effect)

Other negative effects on human health caused by blue light:

- Eye damage (retina, macular degeneration)
- Exposure in late evening impact the circadian rhythm (suppress production of melatonin – prevent sleep)



PEPHA®-AGE CB

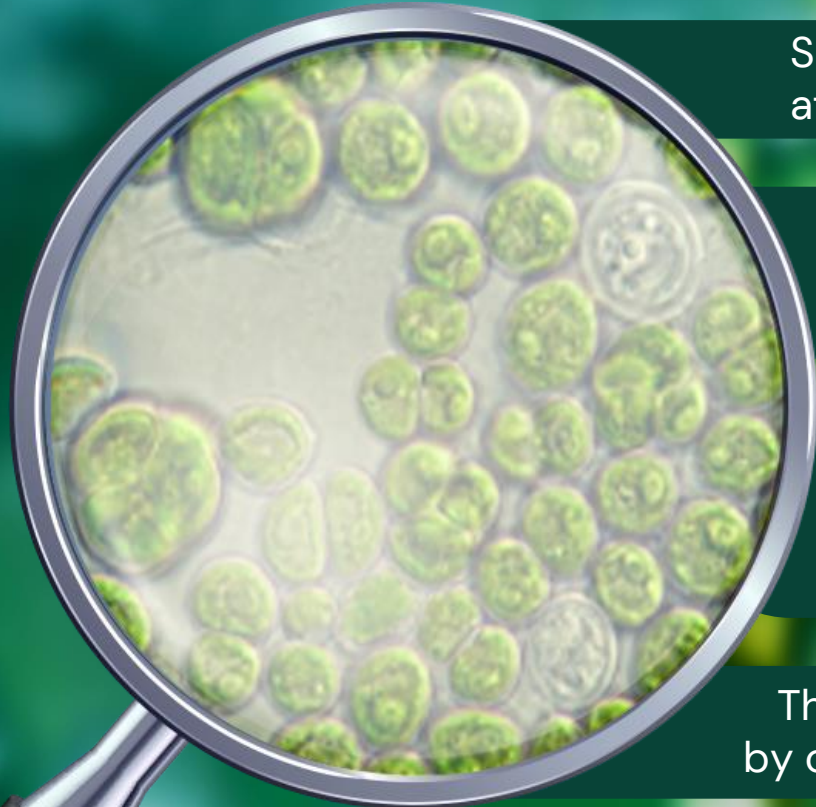
ID Card

INCI name:	Scenedesmus Rubescens Extract, Aqua, Citric Acid, Pentylene Glycol		
TECHNOLOGY:	- Sustainably farmed in photo-bioreactors, guaranteeing maximum quality (no risk of contamination, reproducibility of process, fully traceable) - Derived from Scendesmus rubescens microalgae 100% naturally-derived origin (ISO 16128)		
Technical:	Form: Yellowish-brownish clear liquid Use level: 1-3%	pH of use: 3.0 – 7.5 Preservative: Free	Solubility: Soluble in water
Benefits:	- Prevents skin premature aging - Boosts skin’s own defenses against blue light[†]/^{**} - Reduces blue light induced skin pigmentation (dark spots); evens skin tone^{***}		
Registration certification	  Verified by ECOCERT COSMOS APPROVED Raw material verified by ECOCERT GREENLIFE, conform to the COSMOS Standard  		

^{*} in vitro ^{**} ex vivo ^{***} in vivo

The algae

Scendesmus Rubescens



Selection of the most active micro-algae living in freshwater lakes, after a screening of several species

This **unicellular** organism (5 – 10 μm) has a very strong cell wall, the unique protection against harsh environment (sunlight, current, pollution), which releases an unique set of **active components**.

“**rubescens**” is coming from the latin name ruber (*red*) and escens (*becoming*). This specific species contains red dots, rich in carotenoids (compound known to absorb blue light, red lens scientifically blocks blue light)

This algae has a **circadian cycle** (growing with daylight and multiplying by cellular division in the dark)

Offers a unique variety of relevant active ingredients

PEPHA[®]-AGE CB

Amino-acids

→ Several key amino acids (Proline, Glycine, Alanine, Arginine) stimulating collagen synthesis and boosting epidermal renewing (Glutamic acid).

Vitamins

→ Multifunctional Vitamin B3, plays a central role in cellular metabolism. Energy storage, for healthy skin barrier, even pigmentation, anti-oxidant for multi-functional anti-aging benefits.

Sugars

→ Important mono and oligosaccharides relevant to stimulate cell proliferation and increase of extracellular matrix biosynthesis.

Minerals

→ Zinc, trace element, essential cofactor for biosynthesis of bio molecules for the collagen synthesis.

dsm-firmenich Solution: PEPHA®-AGE CB

Protects from blue light and UV skin damages

Ex vivo, PEPHA®-AGE CB: prevents skin premature aging

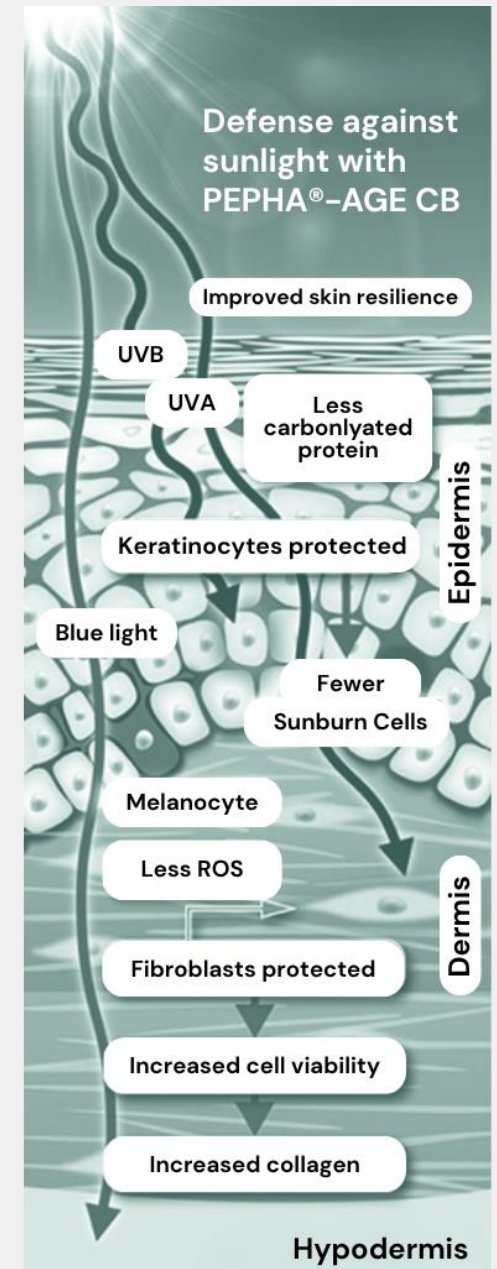
- Protects against oxidative stress. Reduces free radicals (ROS) and carbonylated proteins levels after blue light exposure

In vitro / ex vivo PEPHA®-AGE CB: boosts the skin's own defence

- Stimulates fibroblasts viability and collagen production (collagen III) (*in vitro* & *ex vivo*)
- Protects and repairs Fibroblasts viability against UVA exposure (*in vitro*)
- Repairs the skin barrier function and protects Keratinocytes against UVB (*ex vivo*)

In vivo PEPHA®-AGE CB: evens skin tone

- Reduces immediate blue light induced skin pigment darkening and dark spots
- Reduces immediate blue light induced skin redness
- Rebalances faster to skin normal pigmentation

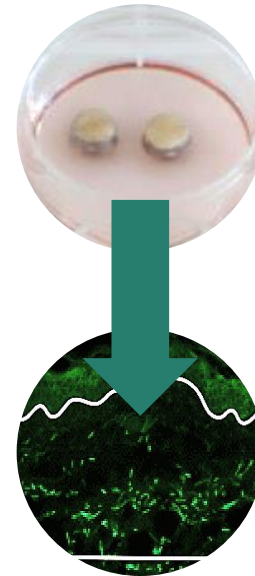
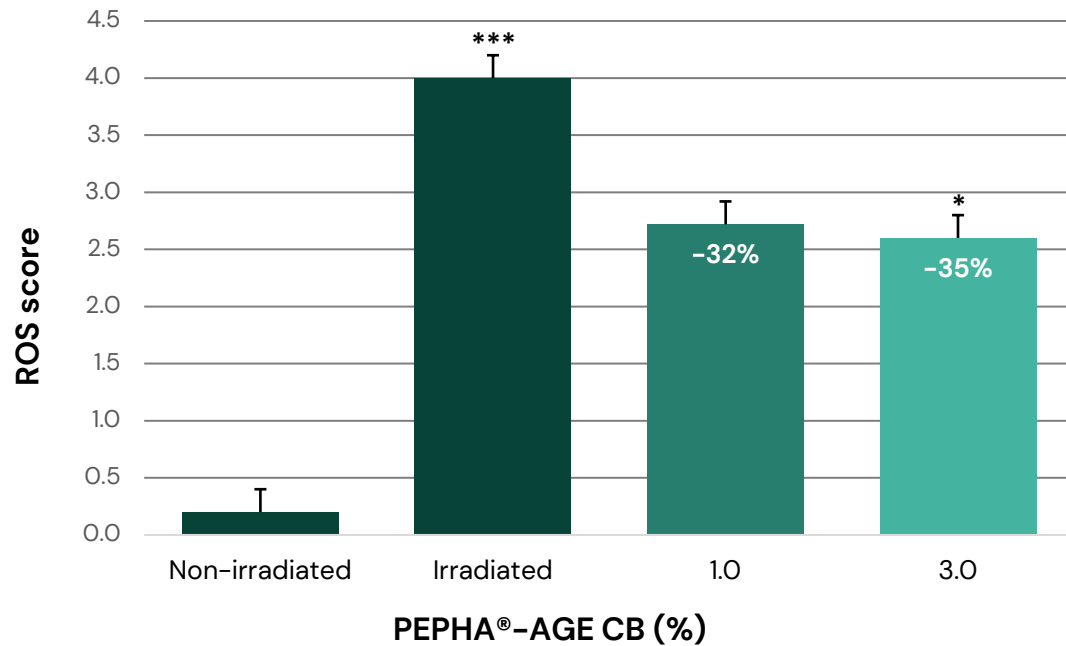


Premature skin aging

PEPHA®-AGE CB reduces blue light induced free radicals up to 35%

ex vivo

Significant reduction of ROS levels (blue light 380–470 nm)



- Topical treatment with products before and after blue light irradiation 100J/cm2*
- Skin biopsies in culture
- Donor: 65-year-old female
- After 24h analysis and quantification of fluorescent signal (green) corresponding to ROS

The ROS reduction leads to drop inflammation reactions and then to reduce skin irritation and redness

* Representing the natural dose of blue light you get within 2 hours from European midsummer sun

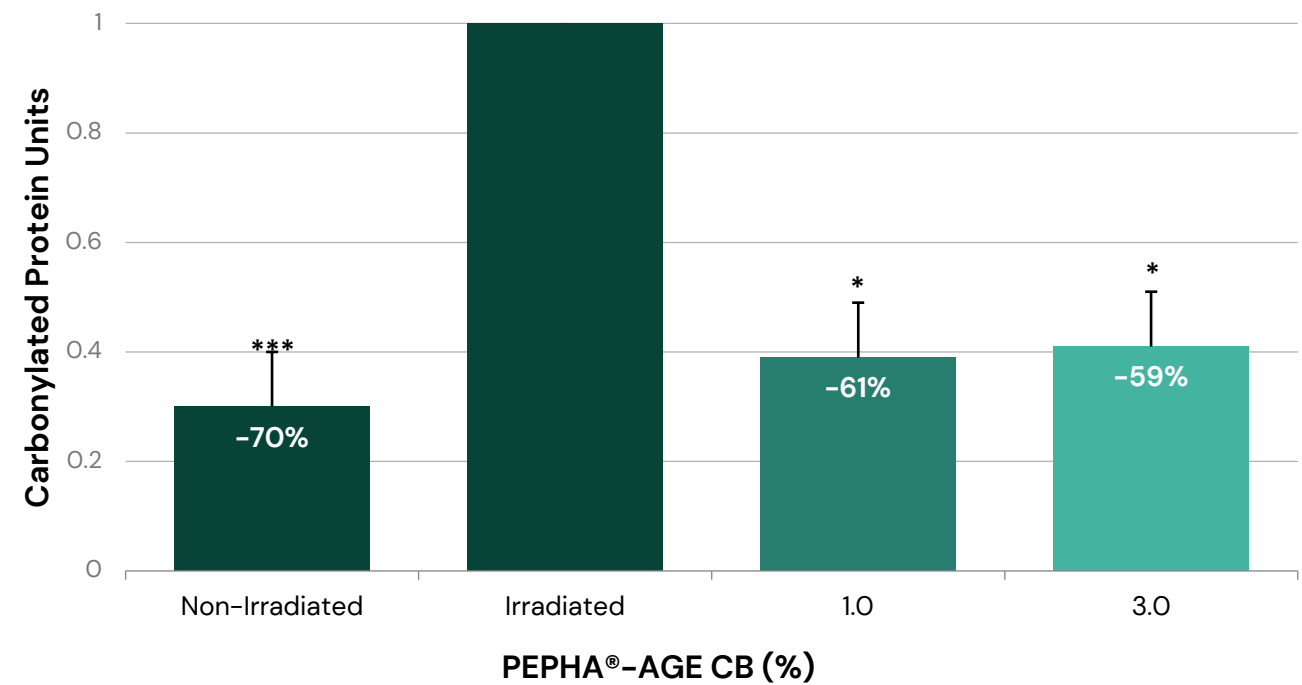
*** p<0.001 vs non irradiated, * p<0.05 vs irradiated blue light

Premature skin aging

ex vivo

PEPHA®-AGE CB reduces blue light induced carbonylated proteins up to 61%

Significant reduction of carbonylated protein levels (blue light 380–470 nm)



- Skin biopsies in culture.
- Topical treatment with products before and after blue light irradiation (100J/cm2).
- Donor: 65-year-old female

Carbonylated proteins result from an irreversible oxidative damage and give a yellowish/brownish color to the skin

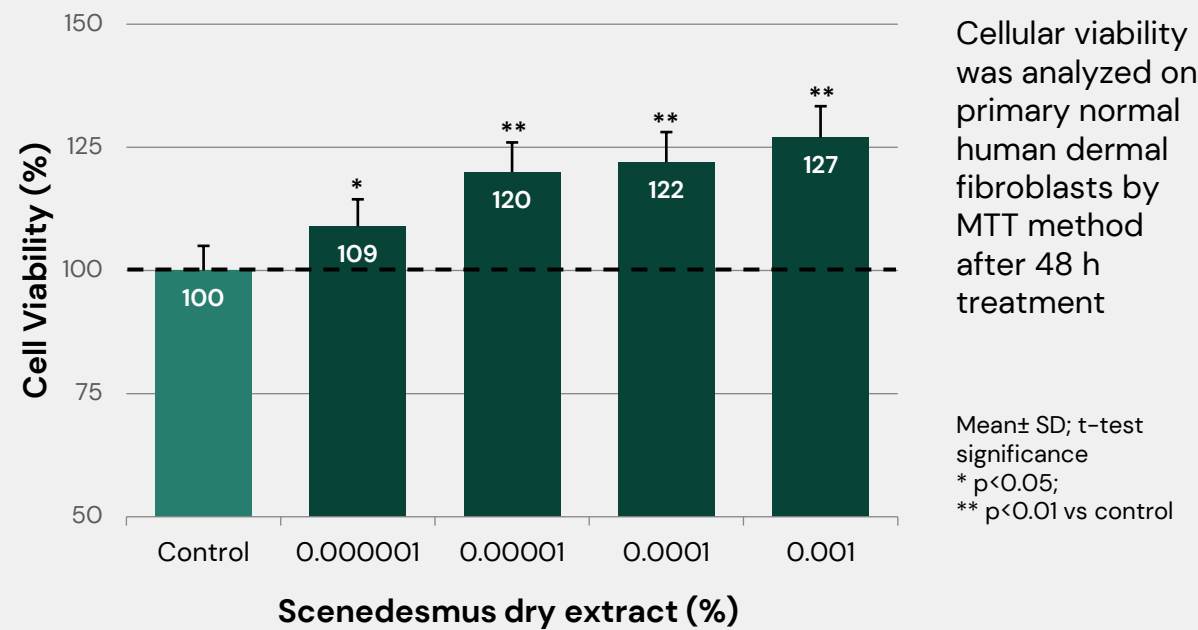
*** p<0.001 vs irradiated blue light; *p,0.05 vs irradiated blue light

Collagen stimulation

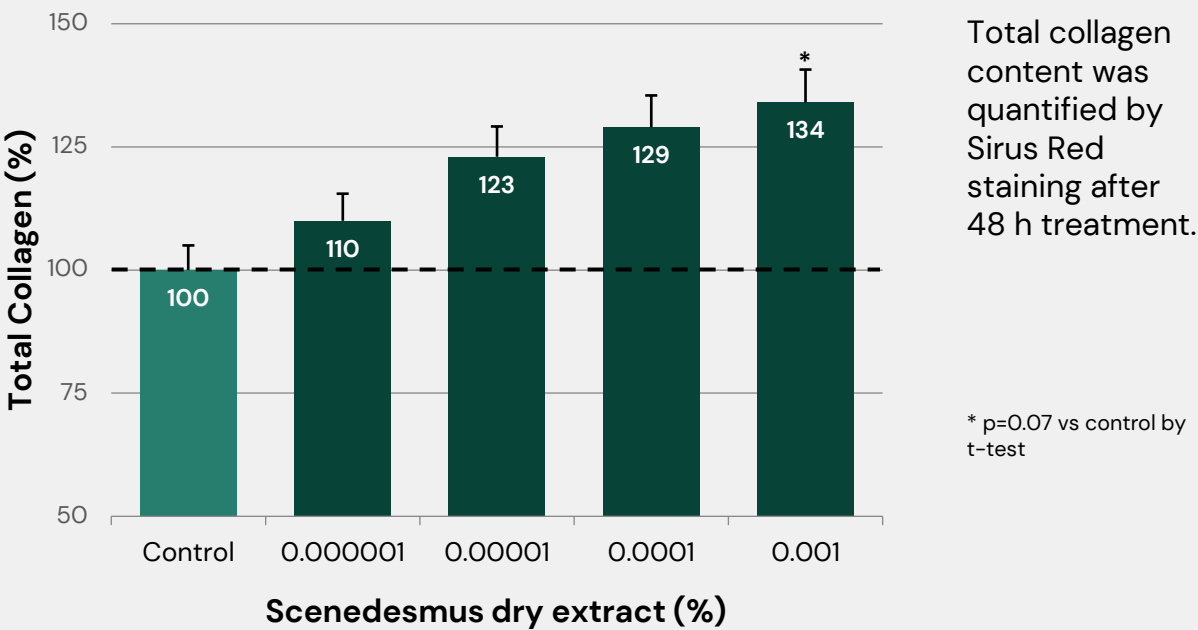
PEPHA®-AGE CB boosts cellular viability and enhances collagen by 34%

in vitro

Stimulates the viability of human dermal fibroblasts



Induced total collagen synthesis in human dermal fibroblasts



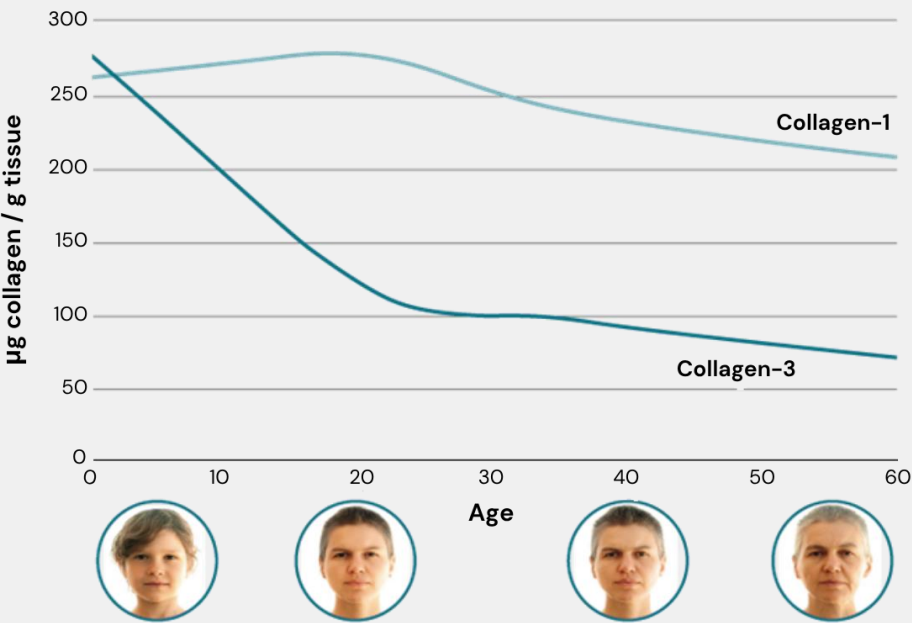
PEPHA®-AGE CB, at low concentration, stimulates in vitro total collagen up to 34% to reduce visible signs of sunlight induced ageing

Collagen III (youth collagen) 29% production boost

PEPHA®-AGE CB

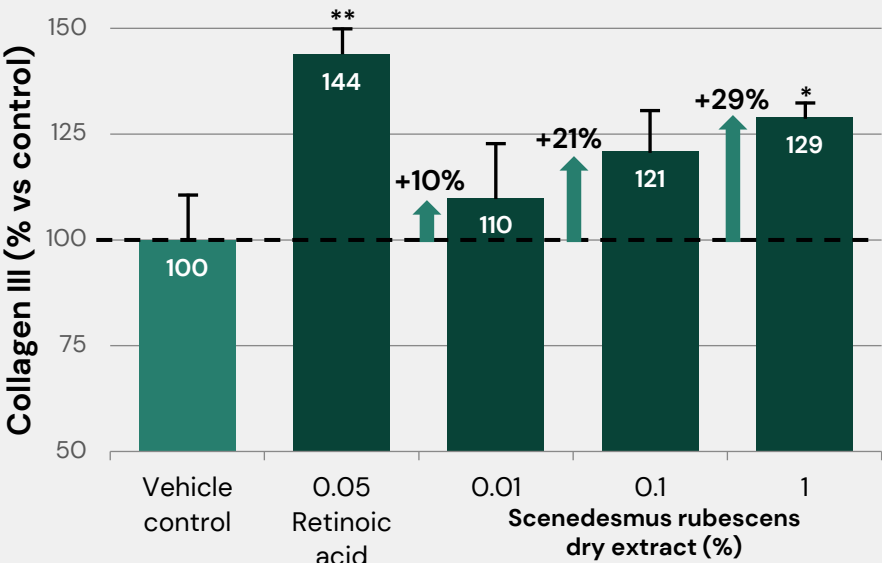
ex vivo

Collagen III dramatically decreases with age



Comparison of daily topical treatments versus DMSO at day 6.
Mean value ± SEM; *p<0.05,
** p<0.01 vs vehicle control by t-test

Collagen III stimulation with PEPHA®-AGE CB



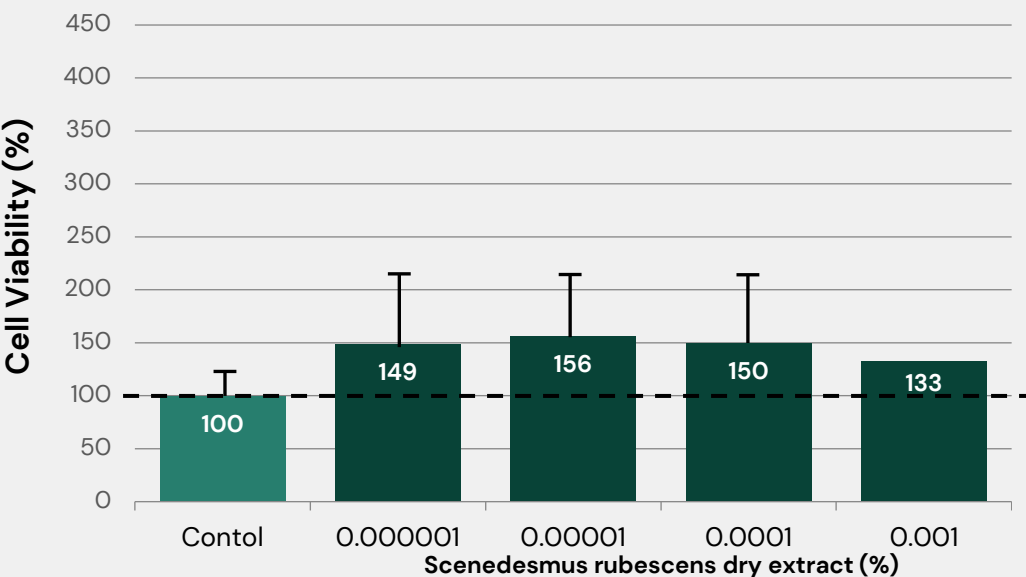
Test samples and control (4 µl) were topically applied on human skin biopsies (Ø 8 mm) for 6 days, donor: 43 years old. Immunohistochemical staining of Collagen type III

PEPHA®-AGE CB significantly strengthens the dermis and reduces visible sign of sunlight induced ageing

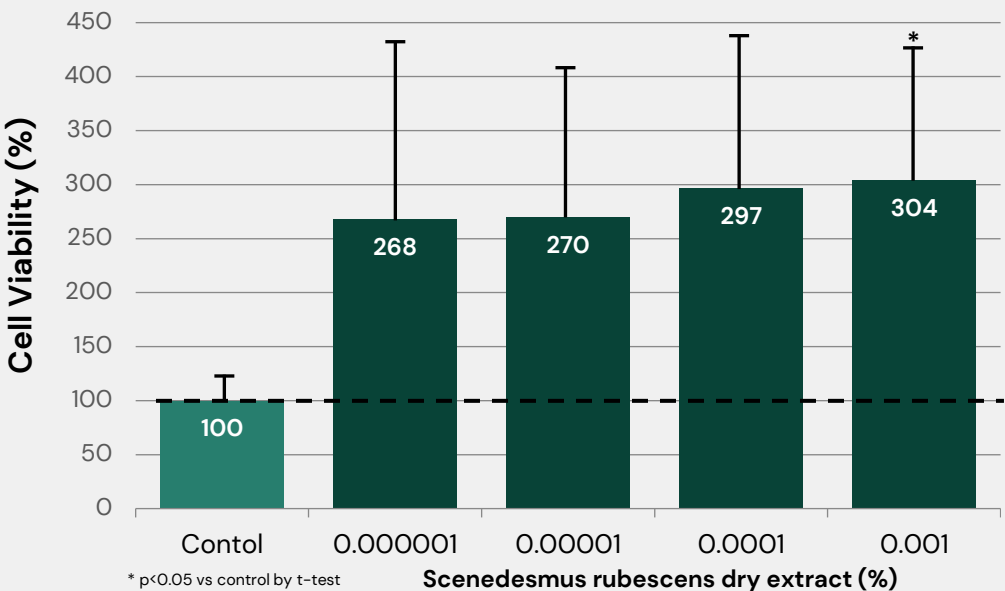
PEPHA®-AGE CB protects and regenerates fibroblasts

in vitro

Cellular protection
PEPHA®-AGE CB: Treatment 1h **before** UVA



Cellular regeneration
PEPHA®-AGE CB: Treatment 1h **after** UVA



PEPHA®-AGE CB protects the fibroblasts (up to 50%) from UV stress and regenerates the fibroblasts functionality (up to 200 %) after UV stress.

Cellular viability was measured 48 h after UVA irradiation (20 J/cm2) using human dermal fibroblasts

Skin barrier repair

PEPHA®-AGE CB reduces the number of sunburn cells by 63% against UVB

Protection of keratinocytes

Sunburn cells are keratinocytes undergoing programmed cell death (apoptosis) after they have received a UVB dose that irreversibly and severely damaged their DNA.

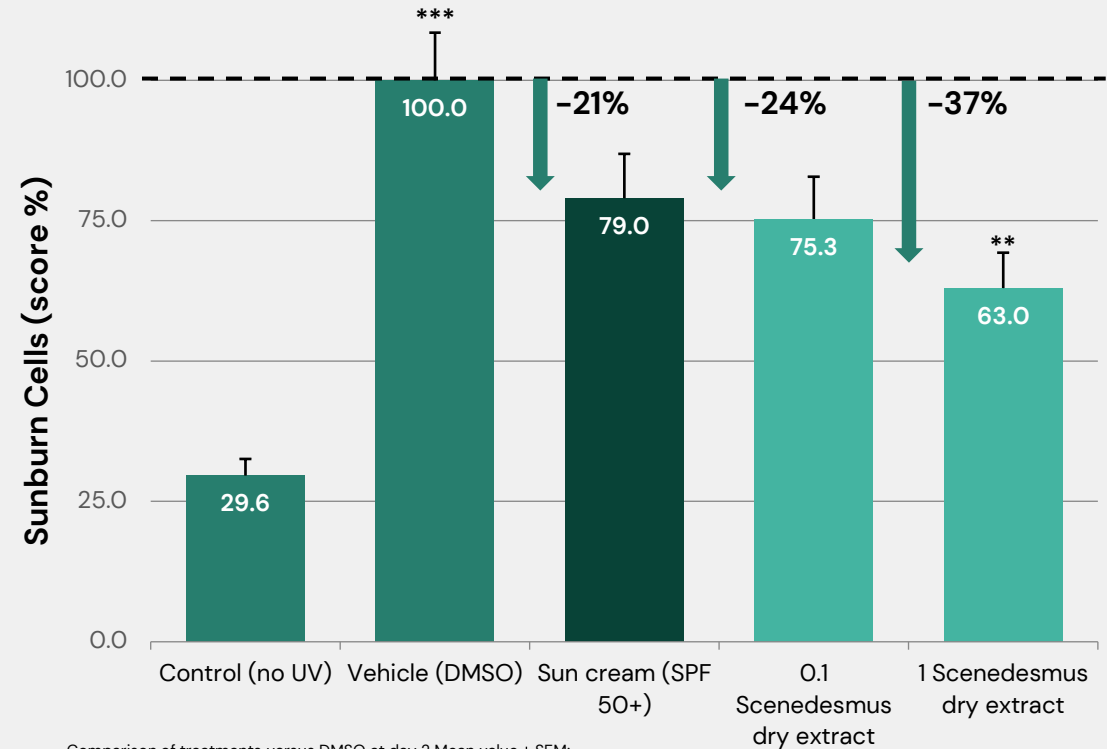
An increasing number is a key indicator for ongoing damage in the epidermis.

PEPHA®-AGE CB protects skin against sunlight induced epidermal damage

*** p<0.001 vs no UV by t-test

** p<0.01 vs vehicle by t-test

in vitro

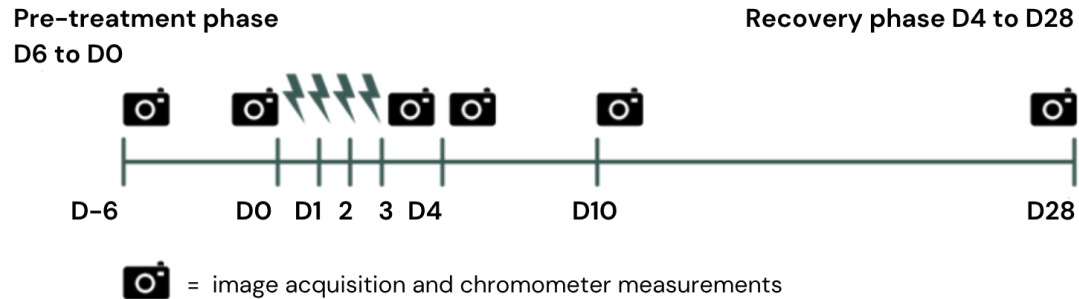


Comparison of treatments versus DMSO at day 2 Mean value $\pm$ SEM;
** p<0.01 vs DMSO; *** p<0.001 vs noUV by (unpaired t-test)

- Test samples and control were topically applied on human skin biopsies
- 24 h and 1 h prior UVB irradiation
- (1 J/cm²) against standard market product SPF 50+

PEPHA®-AGE CB blue light *in vivo* study design

- 33 female volunteers (mean 32 years old, Caucasian 80% and Asian skin 20%)
- Randomized double blind with placebo
- Cream formulations with 3% PEPHA®-AGE CB (without sun filter)
- Forearm application once a day for 34 days (application started 6 days before blue light exposure to strengthen the skin)
- Exposition 4 days consecutively on forearm with LED lamp at 450nm with 60J/cm2*:



in vivo



Skin color measurements (chromameter) and Image analysis

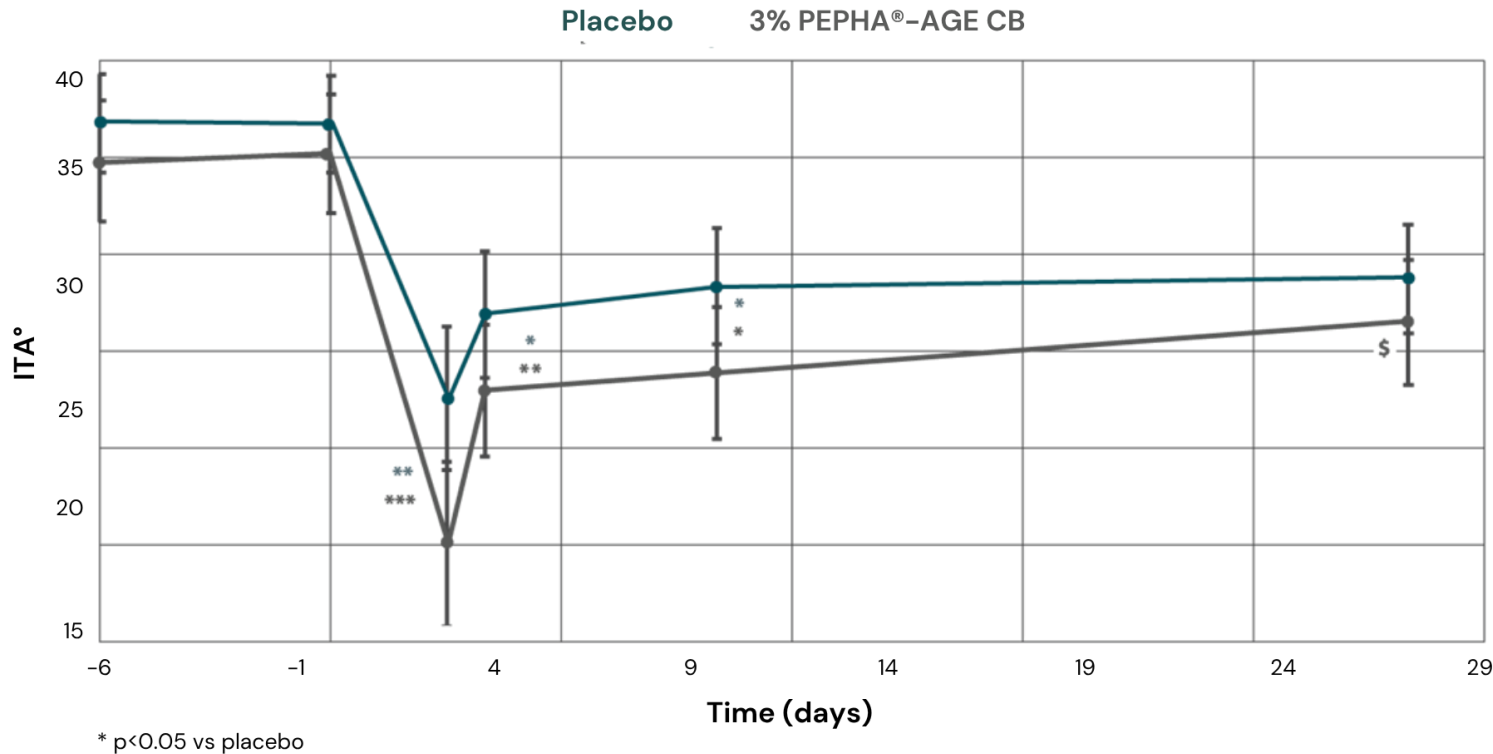
* natural dose you get within one hour from European midsummer sun)

Skin darkening

PEPHA®-AGE CB reduces blue light induced immediate skin hyper-pigmentation by 30%

in vivo

Colorimetry ITA° angle



ITA° is inversely correlated with skin pigmentation: **the lower the ITA value, the darker the skin**
Colorimetry ITA angle, ITA° takes into account 2 parameters: luminance (L*) and yellow-blue tone (b*).

PEPHA®-AGE CB proves to be highly effective against hyper-pigmentation:

- Immediate reduction of skin pigment darkening (-30%)
- Rebalance faster to skin normal pigmentation
- Restores even skin tone

Reduces blue light induced skin pigment darkening

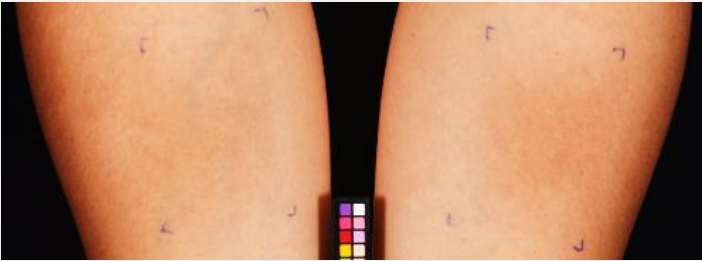
PEPHA®-AGE CB

in vivo

RDO12 right 3% PEPHA®-AGE CB **DO** RDO12 left Placebo



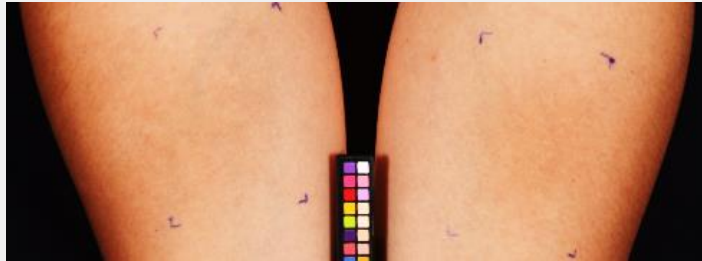
RDO12 right 3% PEPHA®-AGE CB **D4** RDO12 left Placebo



RDO12 right 3% PEPHA®-AGE CB **D3** RDO12 left Placebo



RDO12 right 3% PEPHA®-AGE CB **D10** RDO12 left Placebo



Skin coloration:
ITA°

Volunteer 12 – ITA° – left forearm with placebo and right with 3% PEPHA®-AGE CB

Reduces blue light induced redness

PEPHA®-AGE CB

in vivo

RDO13 right
3% PEPHA®-AGE CB **DO** RDO13 left
Placebo



RDO13 right
3% PEPHA®-AGE CB **D4** RDO13 left
Placebo

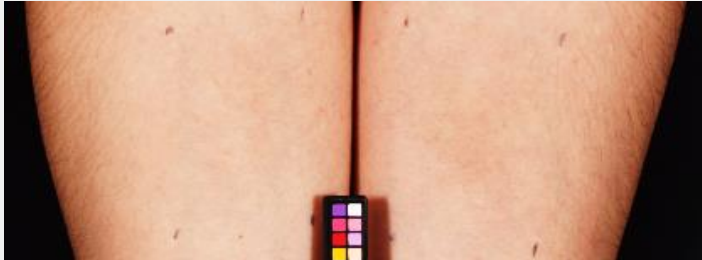


Skin coloration
a* value

RDO13 right
3% PEPHA®-AGE CB **D3** RDO13 left
Placebo



RDO13 right
3% PEPHA®-AGE CB **D10** RDO13 left
Placebo



Volunteer 13 – left forearm with placebo and right with PEPHA®-AGE CB a higher a* value a higher redness

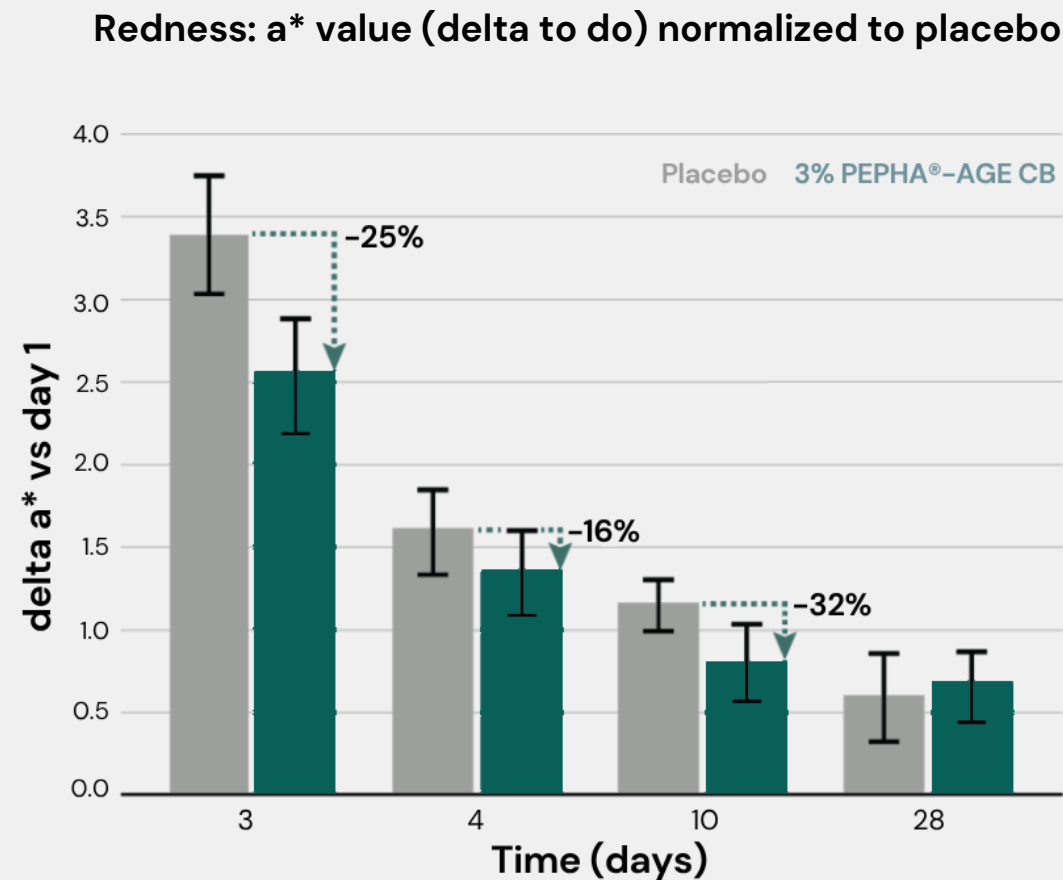
Reduces blue light induced redness

30% reduction of blue light induced skin redness with PEPHA®-AGE CB

in vivo

PEPHA®-AGE CB protects the skin against immediate irritation induced by blue light.

The skin color is less red (-25% with 3% PEPHA®-AGE CB compared to placebo) just after 4 days blue light irradiation



Formulation Guidelines

PEPHA®-AGE CB

INCI name (active): Scenedesmus
Rubescens Extract

- Clear yellow-brownish to brown liquid
- Stable at pH ranges from 3.0 to 7.5
- Should be processed below 40°C
- Suggested concentration: 1–3 %

Cosmetic application

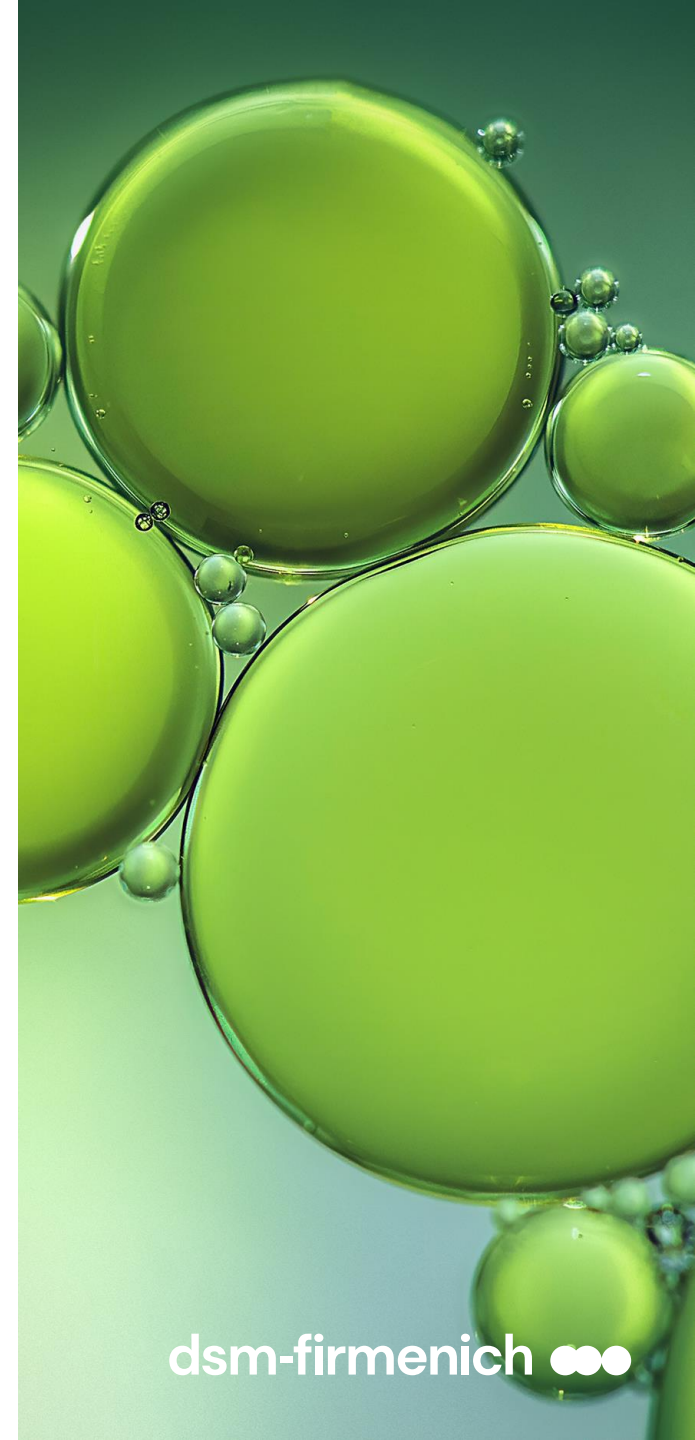
- Day care products
- Sun care and after sun formulations
- Regenerative night care
- Anti-aging products



PEPHA[®]-CTIVE

Supported marketing claims

- Minimizes the appearance of ageing after exposure to blue light and UV
- Reduces skin damage caused by natural and artificial blue light sources
- Improves overall skin appearance and offers an even skin tone



Disclaimer

Copyright © DSM Nutritional Products Ltd 2025, 4002 Basel, Switzerland.
www.dsm-firmenich.com. All rights reserved.

dsm-firmenich has used diligent care to ensure that the information provided herein is accurate and up-to-date to the best of its knowledge. However, dsm-firmenich makes no representation or warranty, either expressly or implied, of the accuracy, reliability, completeness, or suitability thereof. The information provided herein contains scientific and product information for business-to-business use and does not constitute or provide scientific or medical advice, diagnosis or recommendation for treatment options. Country or region-specific information should be considered when labelling or advertising to final consumer. In no event shall dsm-firmenich be liable for any direct or indirect damages arising from or reliance upon, or use of, any information provided herein. The content of this document is subject to change without further notice. Please contact your local dsm-firmenich representative for the latest information. All trademarks listed in this document are either (registered) trademarks of, or trademarks licensed by, the dsm-firmenich group of companies, unless explicitly stated otherwise.

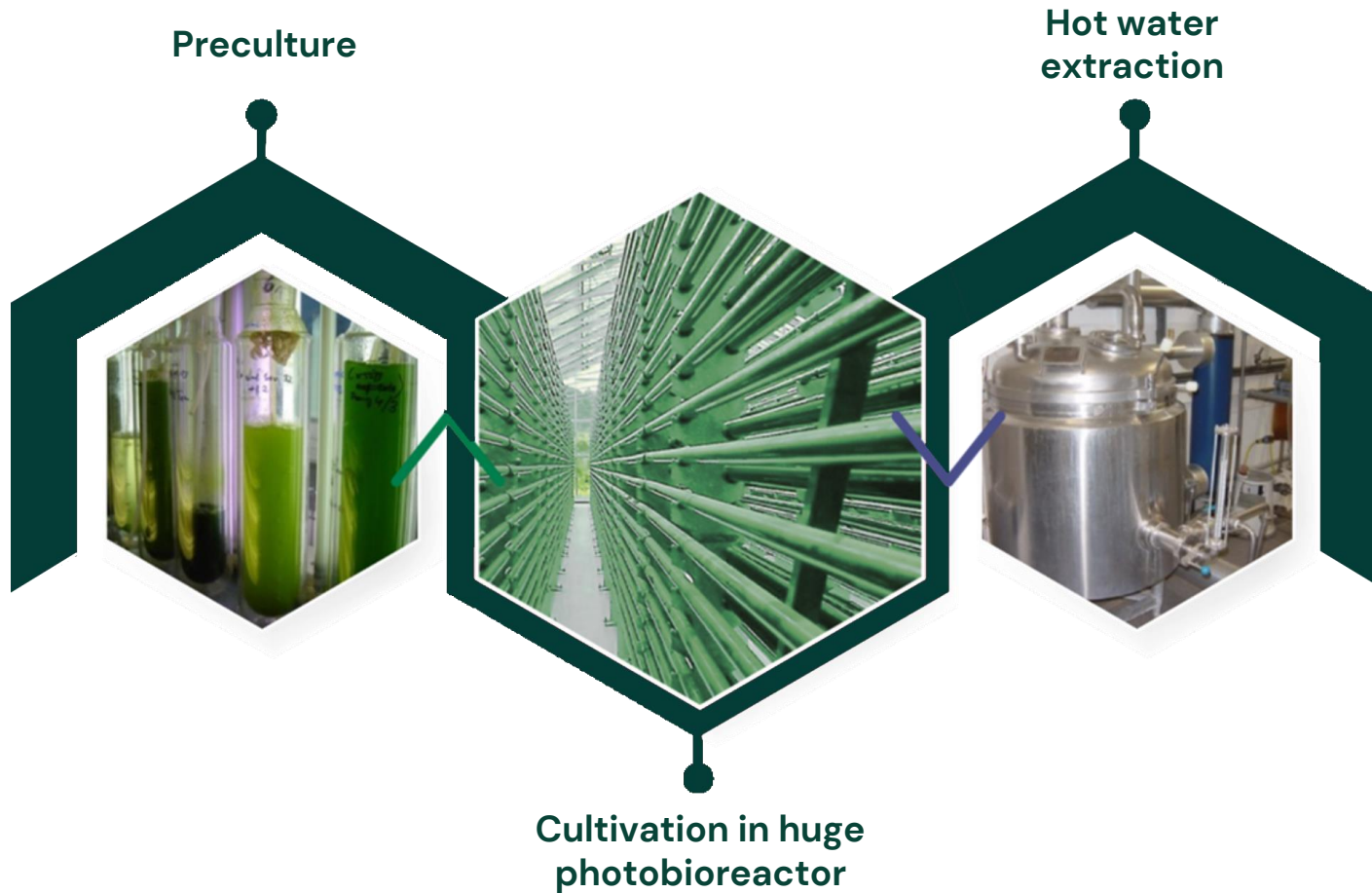
Disclaimer Formulation Guideline

The information provided herein is provided for information purposes only and has been prepared by dsm-firmenich in accordance with its own methodology. dsm-firmenich has used diligent care to ensure that it is accurate and up-to-date, however, dsm-firmenich makes no representation or warranty, either expressly or implied, of the accuracy, reliability, or completeness thereof. In no event shall dsm-firmenich be liable for any damages arising from or reliance upon, or use of, any information provided herein. Further, dsm-firmenich shall not bear any liability for the application and/or use of any processed material containing its product(s). The formulation of the finished product is the customer's sole responsibility. It is the customer's responsibility to determine the suitability of dsm-firmenich's products regarding user specific purposes, assess compatibility and stability of their finished product(s) and to ensure compliance of their finished product(s) with relevant laws and regulations. Any product, marketing or other claims made by customer are its sole responsibility. The content of this document is subject to change without further notice. Please contact your local dsm-firmenich representative for further details. © 2025 dsm-firmenich group.

We bring progress to life

The production process

A special growth by photobioreactors, for maximum quality & sustainability



- Maximizes the optimal growth conditions by providing sufficient light and minimizes the contamination risk: **purity, high quality and high content of active substances** are ensured
- Enables standardization
- Respects biodiversity
- High level of renewable sources of energy

Skin Darkening

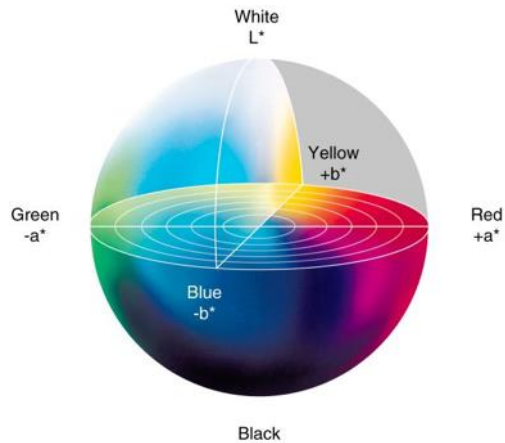
Blue light irradiation provokes immediate pigment darkening

in vivo

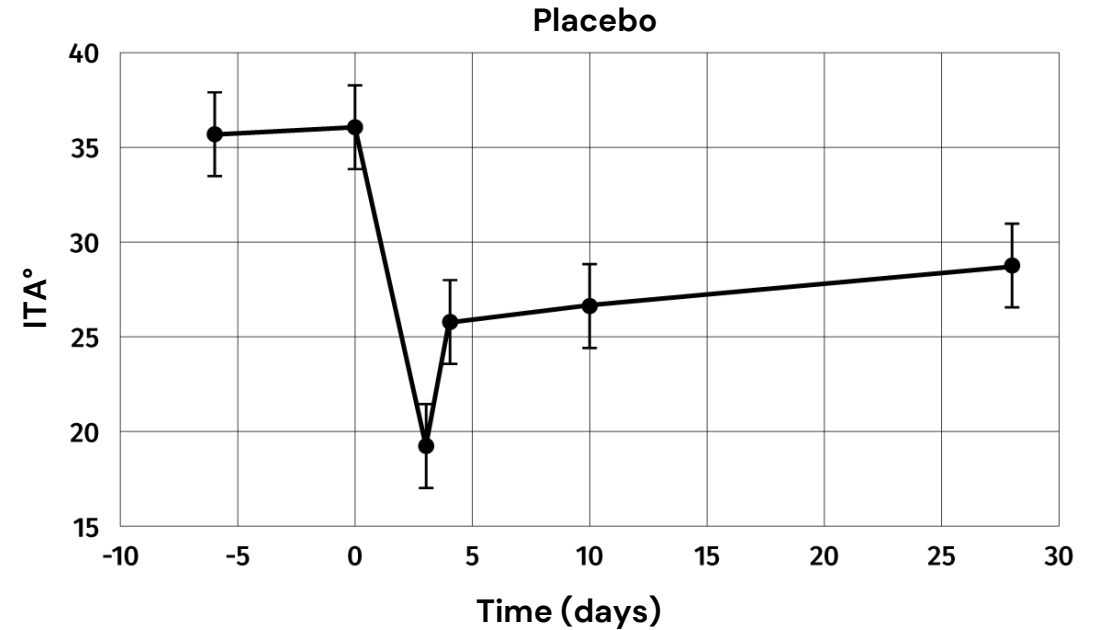
Measurements of pigment darkening

Colorimetry ITA angle, ITA° takes into account 2 parameters of the color: the luminance (L^*) and the yellow-blue tone (b^*).

It is inversely correlated with skin pigmentation: **the lower the ITA value, the darker the skin**



\$ $p < 0.1$
* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$
all vs baseline day 0

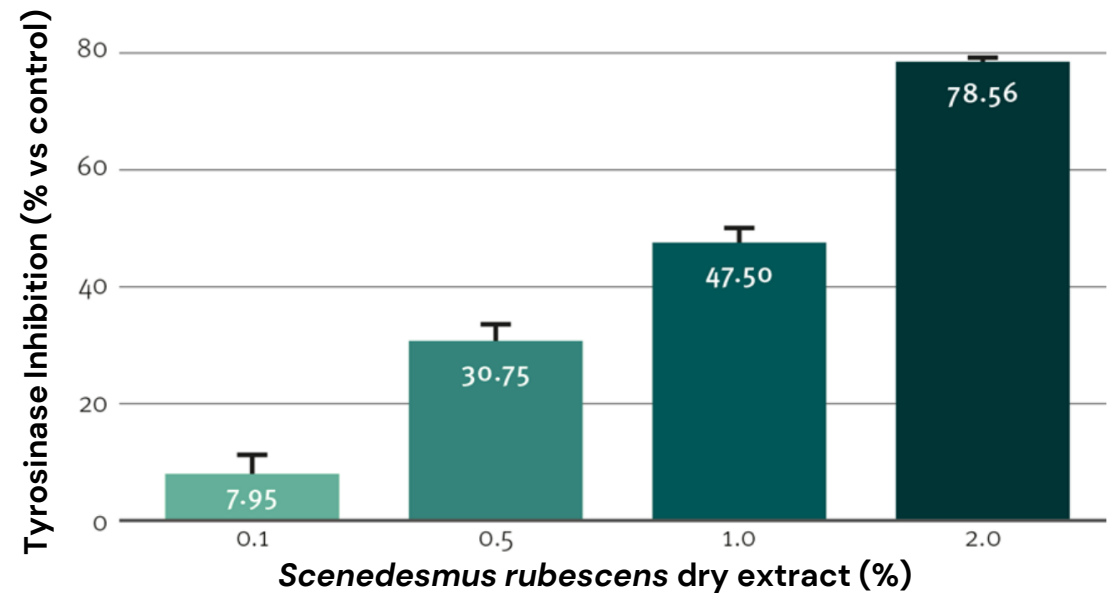


Blue light irradiation for 4 days darkens immediately and significantly the skin (strong coloration -15°ITA)

PEPHA®-AGE CB Inhibited tyrosinase activity

in vitro

Activity of mushroom tyrosinase (Sigma) as a function of Scenedesmus extract concentrations determined based on the enzymatic conversion of L-DOPA to dopachrome:

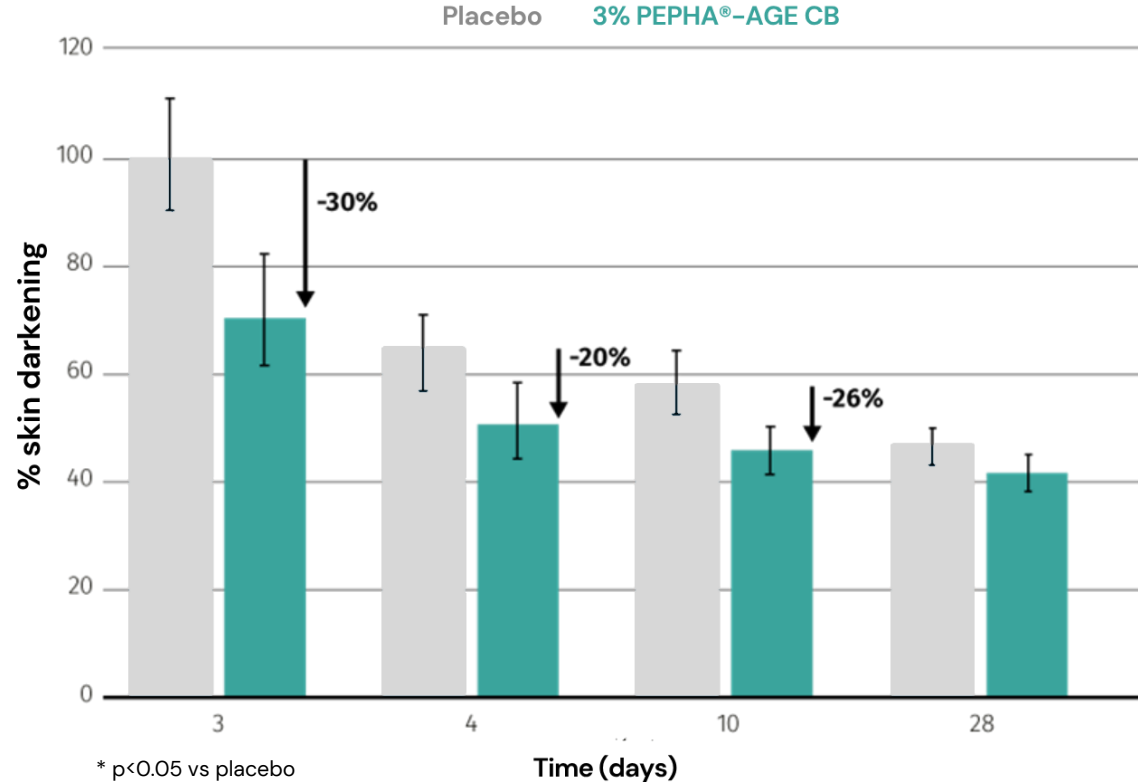


PEPHA®-AGE CB helps to reduce blue light induced hyperpigmentation to achieve an even skin tone

Skin Darkening

in vivo

PEPHA®-AGE CB reduces blue light induced immediate skin hyper-pigmentation by 30%



PEPHA®-AGE CB protects the skin better than placebo:

- Immediate reduction of skin pigment darkening (-30%)
- Rebalance faster to skin normal pigmentation
- Provides even skin tone

Colorimetry ITA° angle (delta to D0), normalized to 100% with placebo at D3

Reminder: at D4, not anymore blue light irradiation

Going beyond on blue light protection

To complement PEPHA®-AGE CB activity on blue light...

You might consider adding these ingredients for full protection...

1. Sun filters

- „blocking also blue light“ beyond UV protection
- Key active: PARSOL® Max and PARSOL® TX

2. Vitamins: Anti-oxidant

- Counteracts oxidative stress at skin surface
- Key active: Niacinamide PC and Tocopherol

3. Nutraceuticals

- Carotenoids, lutein and Zeaxanthin, as blue light absorbers
- Key active: FloraGLO Lutein

