

# Les Rendez-Vous de Concarneau 2023

## Concarneau Marine station – November, 9-10 2023

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Bioinspiration from marine mycosporine-like amino acids (MAA) for skin photoaging protection: an ecobiological approach

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Care first.

**BIODERMA**  
LABORATOIRE DERMATOLOGIQUE

INSTITUT  
ESTHEDERM  
PARIS

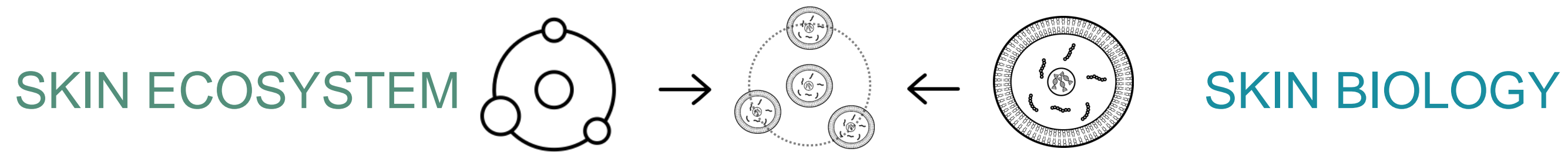
état pur

 NAOS

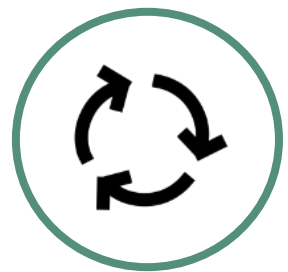


# Skin, a living ecosystem

# A unique approach inspired by life



## CONSIDER SKIN AS AN ECOSYSTEM



A dynamic ecosystem full of living cells interacting together and with their environment  
Leave a positive footprint in this ecosystem

## INTERACT WITH NATURAL MECHANISMS

Support and strengthen natural skin's abilities  
Help the skin to adapt and regain its balance itself



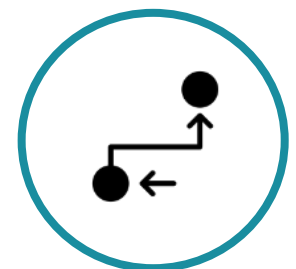
## BE DRIVEN BY BIOMIMETISM



Observe what nature does best to develop effective & sustainable solutions  
Healthy skin is our first model

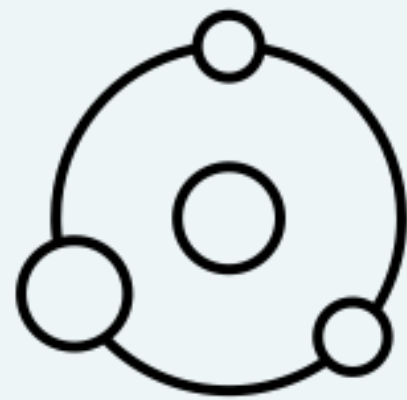
## ACT ON CAUSES BEFORE CONSEQUENCES

Adopt a comprehensive approach  
Act deeply on the root causes of issues to provide a lasting solution

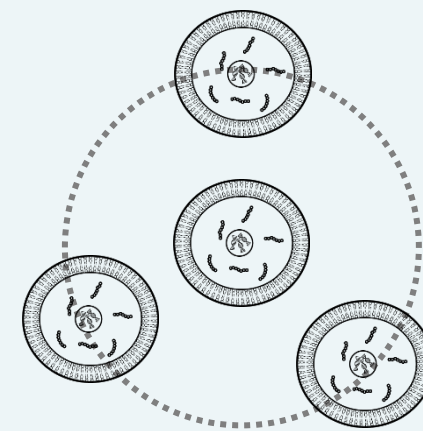


AND COMMITTED TO CARE

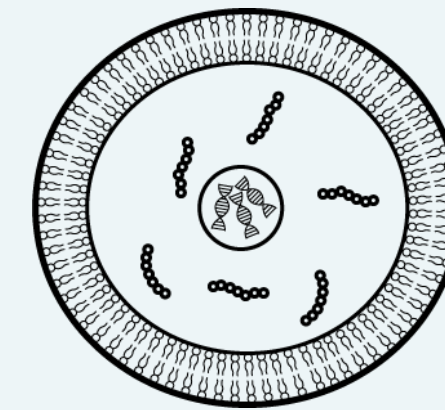
Preserve skin's natural resources



SKIN  
ECOSYSTEM



SKIN  
ECOBIOLOGY



SKIN  
BIOLOGY

Support skin's biological functions





# Ecobiology in formulation

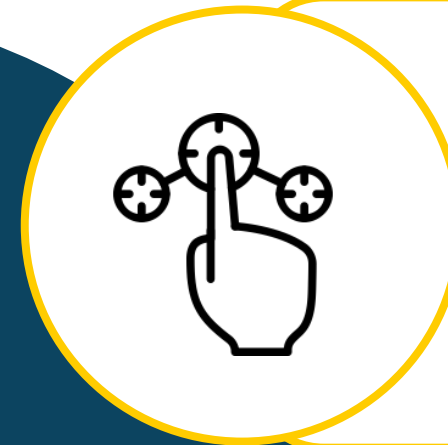
## PREFER BIOMIMETIC INGREDIENTS

= directly assimilated into the skin  
E.g.: Skin identical lipids (sphingolipids)



## PREFER POLYFUNCTIONAL INGREDIENTS

= active galenic ingredients  
E.g.: gelling hyaluronic acid



## ECOBIOLOGICAL FORMULATION

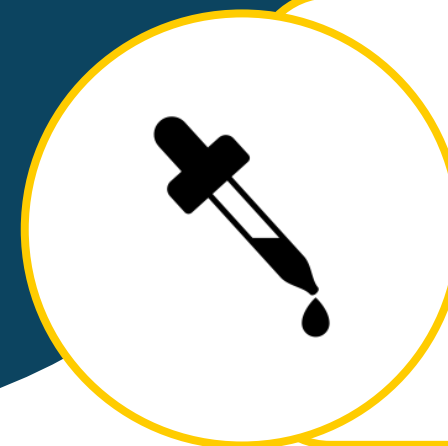
## PREFER PURE ACTIVE INGREDIENTS

= cleared from useless or undesirable components  
E.g.: Pure vitamin C vs fruit extract



## ADJUSTED DOSE OF ACTIVE INGREDIENTS

= the most effective dose, no more, no less  
E.g.: 10% vitamin C



We have selected **650** ingredients out of **30,000** (only **2%**)

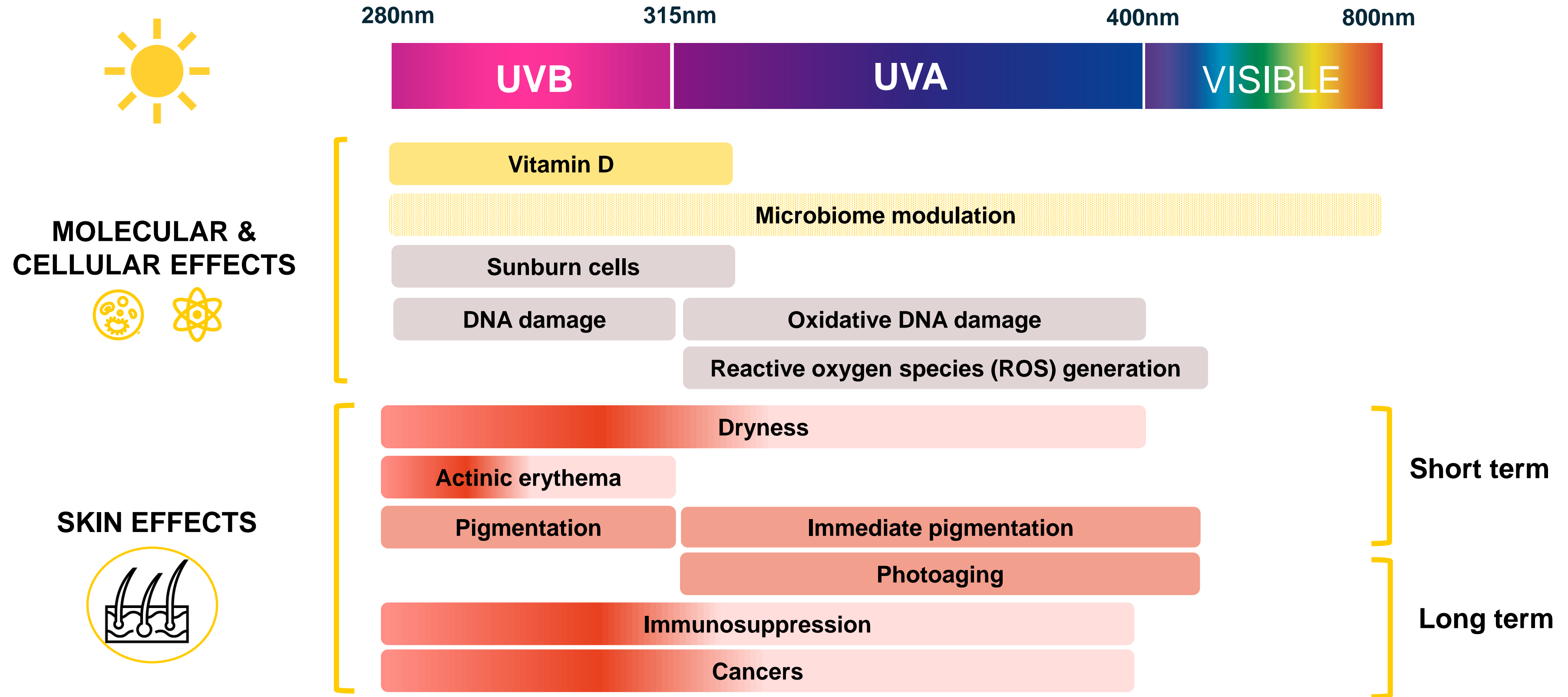
We are committed to leave a positive footprint in the skin ecosystem.

# Sun & skin ecosystem

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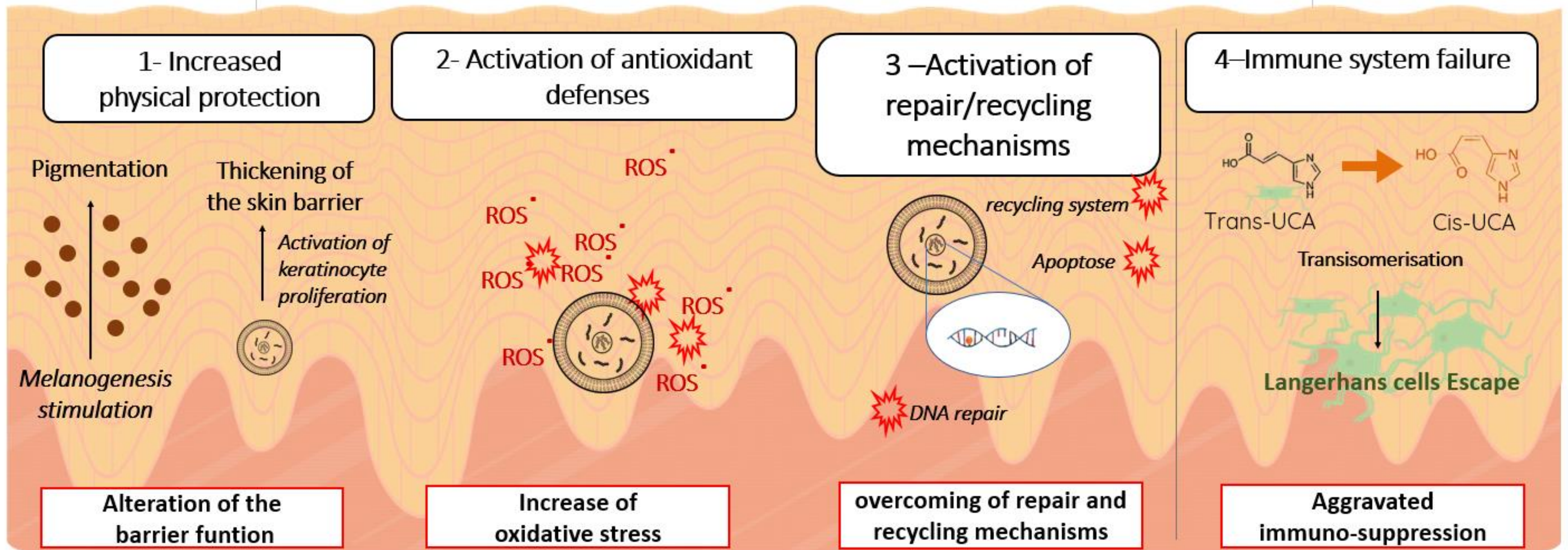
# Ultra-Violet (UV) rays' impact on skin ecosystem



Chronic sun exposure leads to long-term skin damages.



# Skin natural photoprotection



- non-enzymatic syst. : vitamin E/C, glutathione...
- enzymatic syst. : glutathione peroxidase/reductase, catalase...

UCA = urocanic acid

In chronic sun exposure, skin's defense mechanisms are reduced leading to long term effects, as photoaging.



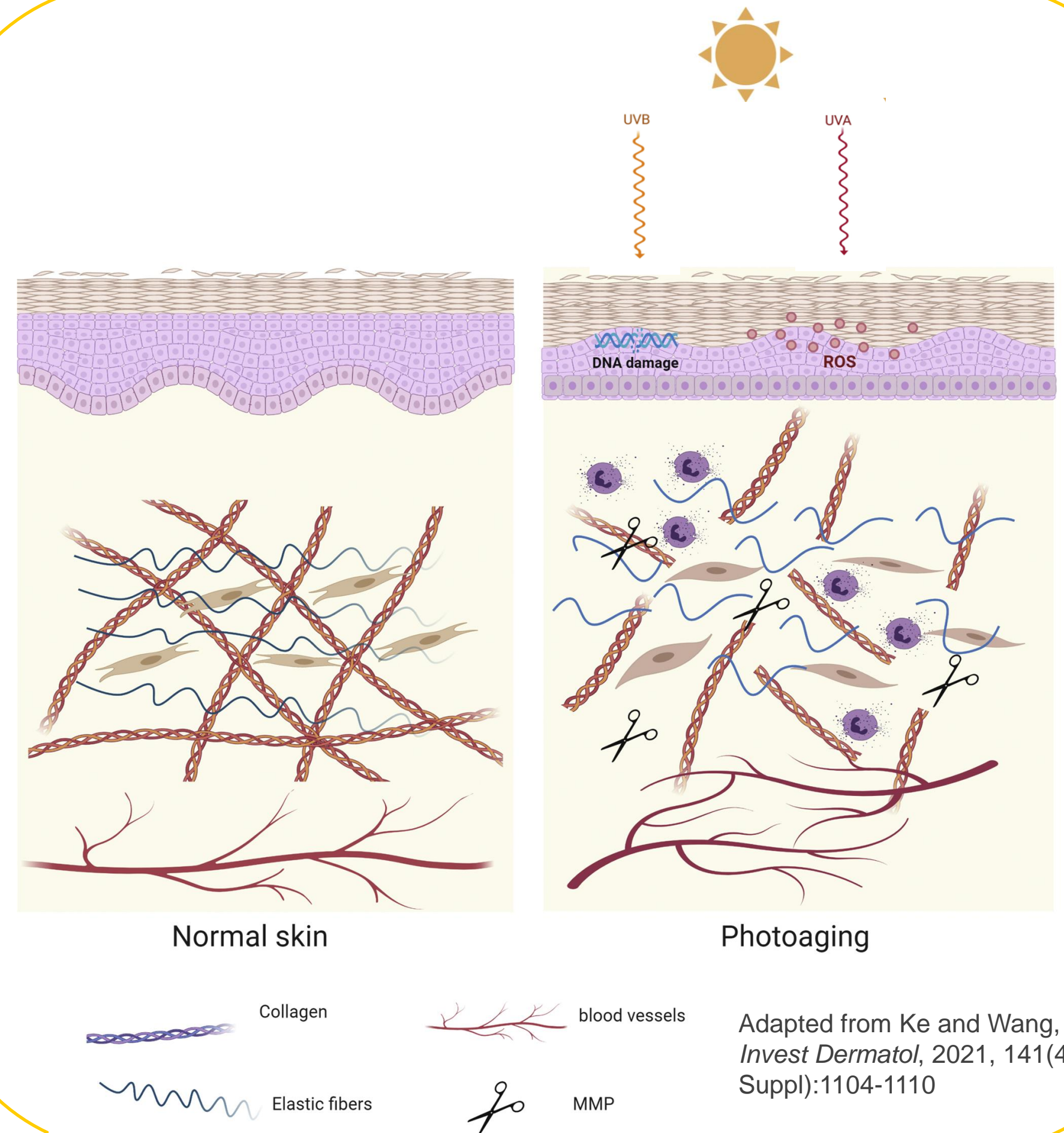
# Photoaging

Reactive oxygen species  
inflammaging

Metalloproteinases  
(MMP) release

Collagen and elastin  
degradation

Wrinkles, loss of elasticity,  
laxity, vasodilatory disorders



In photoaging, need to reinforce the antioxidant properties.

# Bioinspiration of other organisms

## Mycosporine-like amino acids (MAA)

### SOURCES

- Dinoflagellates
- Cyanobacteria
- Microalgae
- Seaweeds
- Sea stars
- Corals
- Fungi
- Lichen



from Gerald V. and Pinto E. *Pharmaneuticals* 2021 (14) 63



# Why bioinspiration of MAA?

## SOURCES

- Dinoflagellates
- Cyanobacteria
- Microalgae
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- Sea stars
- Corals
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## Mycosporine-like amino acids

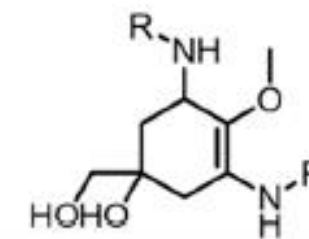
## COSMETICAL APPLICATIONS

- Natural sunscreens
- Antioxidative activity
- Anti-inflammatory property
- Antiaging function
- Inhibition of protein-glycation
- Inhibition of collagenase activity



## BIOLOGICAL FUNCTIONS

- Photoprotection
- Antioxidants
- Osmotic balance
- Thermal stress
- Desiccation stress
- Nitrogen storage
- Reproductive regulation
- Ecological interaction



## OTHER APPLICATIONS

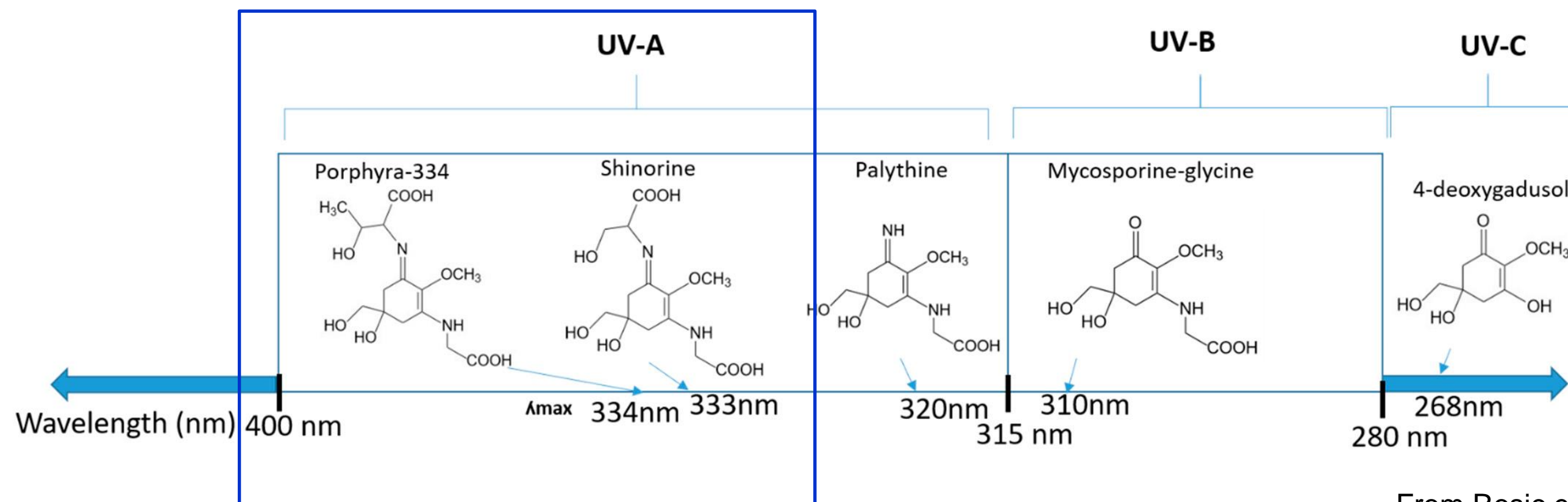
- Pharmaceutical, biomedical, and biotechnological field
- Nonmedical application

Mycosporine-like amino acids sources, biological functions and applications  
(from Geraldes V. and Pinto E. *Pharmaceuticals* 2021(14) 63)



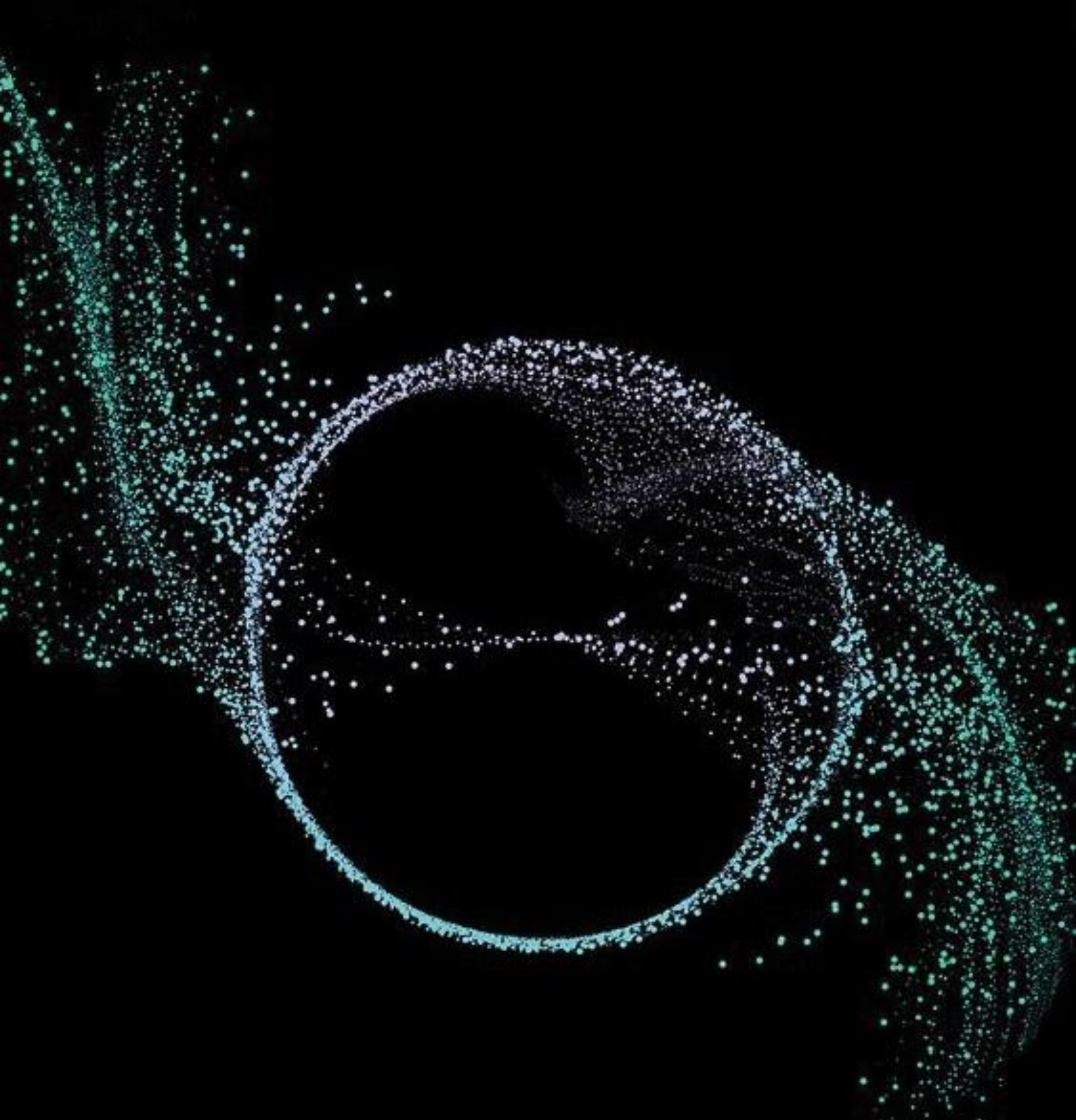
# Mycosporine-like amino acids

- \* Low-molecular-weight secondary metabolites (generally < 400 Da), colorless, water-soluble, highly stable under environmental conditions.
- \* Most abundant MAAs found in nature include shinorine, porphyra-334, palythine, and mycosporine-glycine.



From Rosic et al *Mar Drugs* 2023 (21) 253

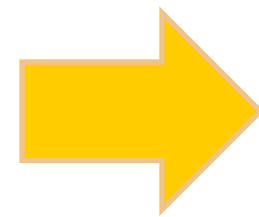
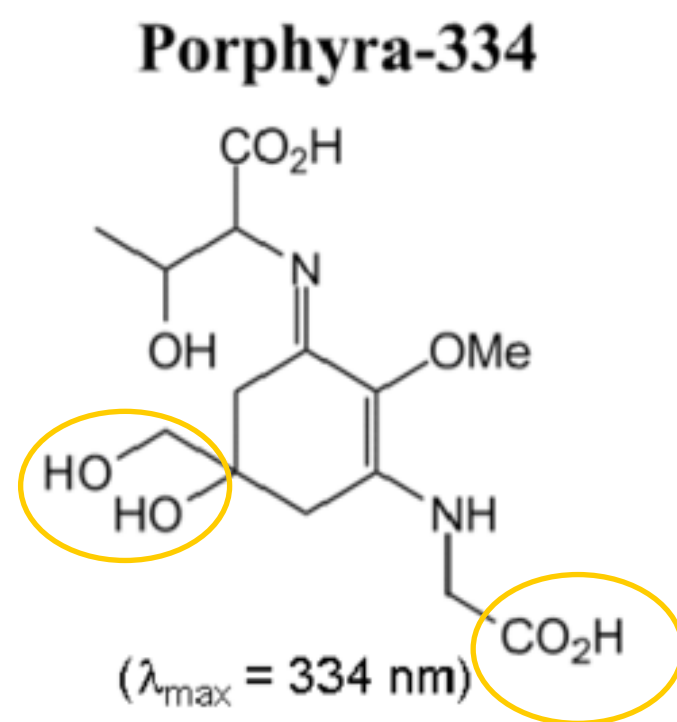
**BUT** for cosmetic ingredient, mostly **colored extract** from red seaweeds with **low concentration** of MAA (<1%) in addition with the presence of **solvent and preservatives**.



# An ecobiological MAA

# Co-development of an ecobiological MAA-like

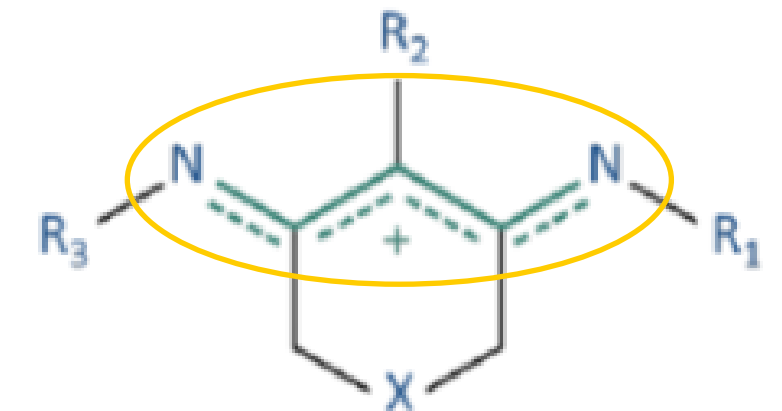
- \* Collaboration to elaborate a synthetic MAA : **pure** with similar chemical structure derived from MAA **by green chemistry**.
- \* **AIM:** to optimize its structure for formulation while keeping its UV absorption and antioxidative properties.



Keep the conjugated system (even longer)  
> **UV absorption and antioxidative properties**

Replace the acidic function by an esterified one  
> **more stable in formulation**

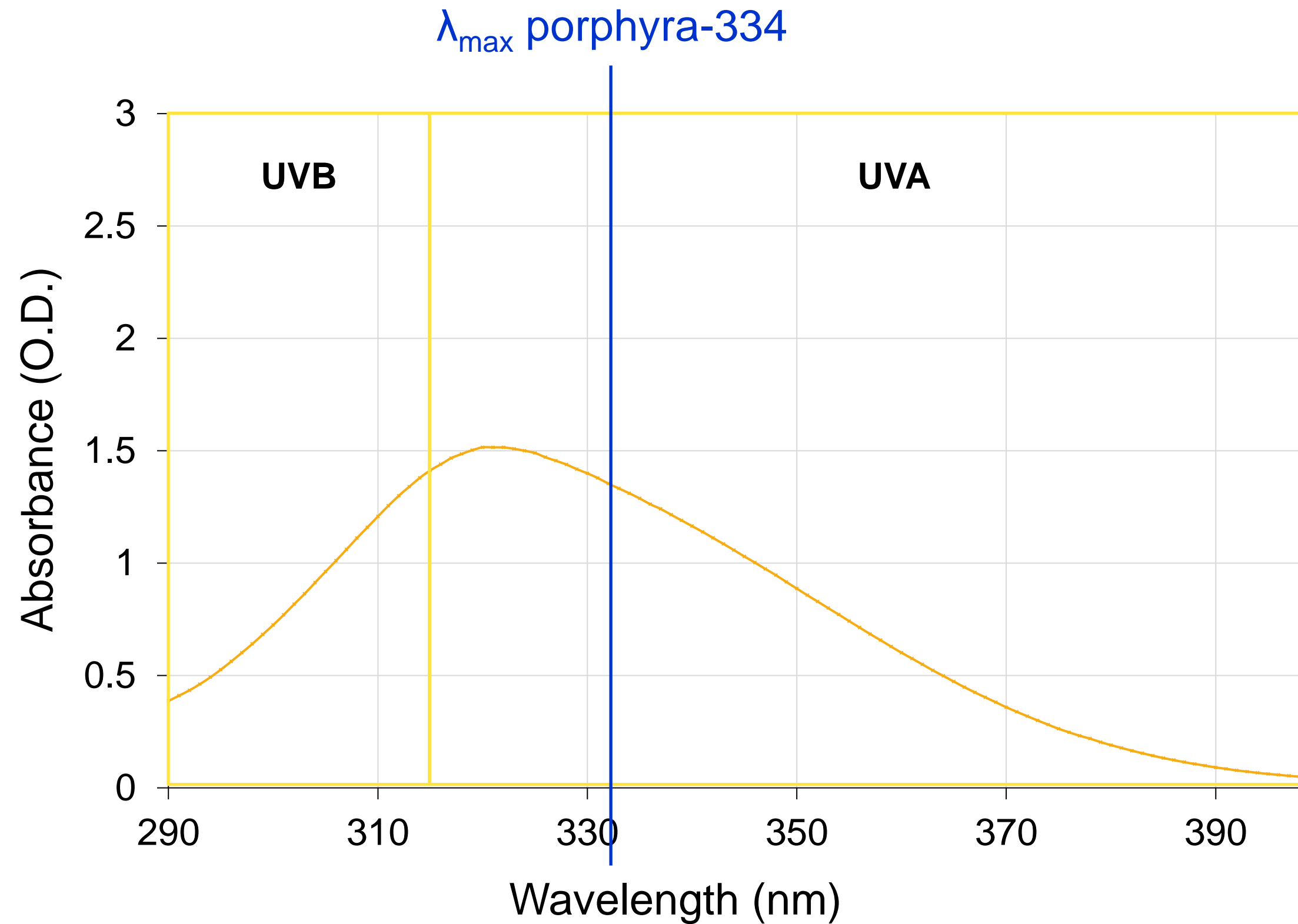
Simplify some functions difficult to reproduce  
> **fewer steps and less expensive to synthesize**



A pure MAA-like inspired by the chemical structure of MAA.

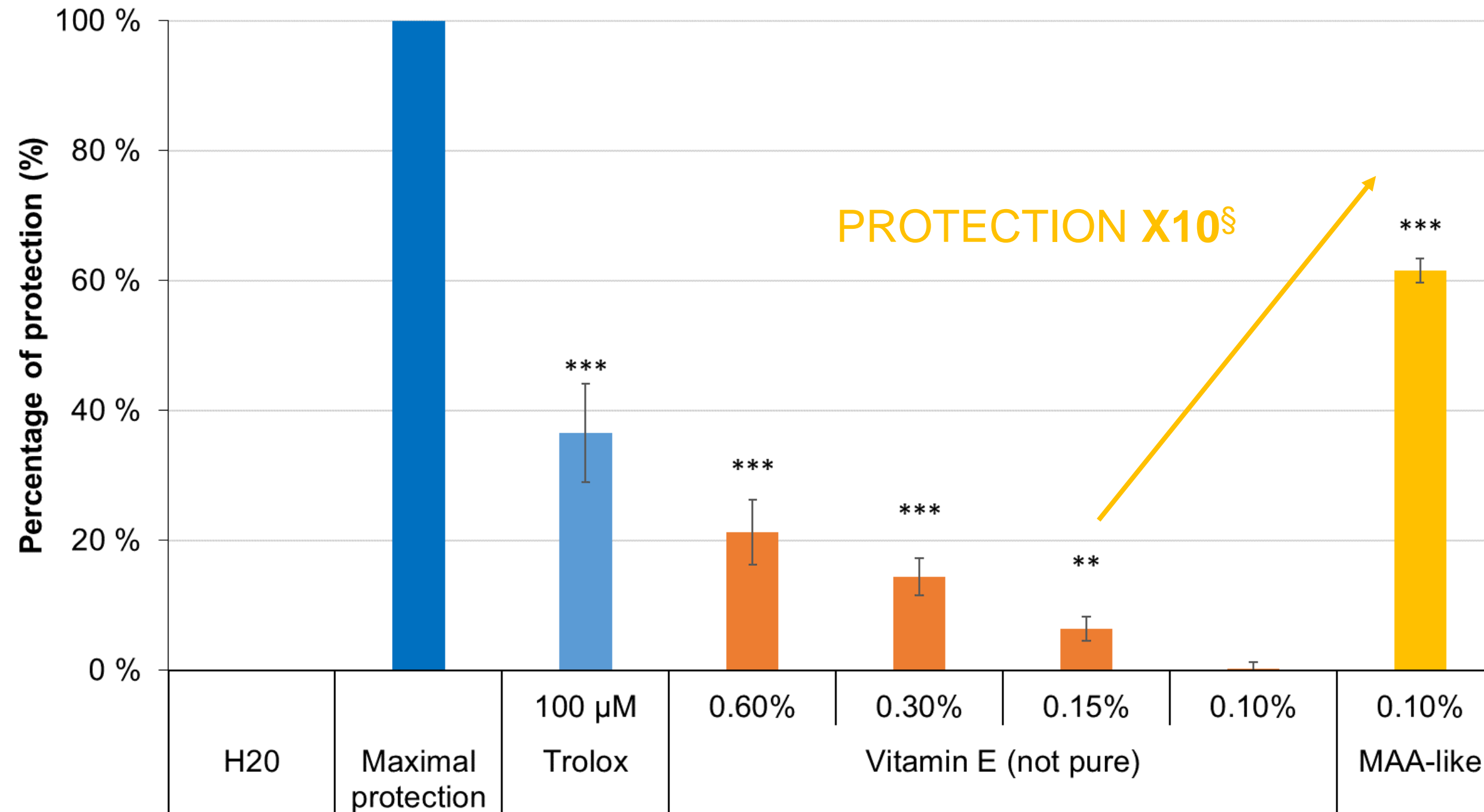


# Photoprotection of the MAA-like: UV absorption



The ecobiological MAA-like absorbs in UV.

# Antioxidative properties of MAA-like: ORAC test vs Vitamin E



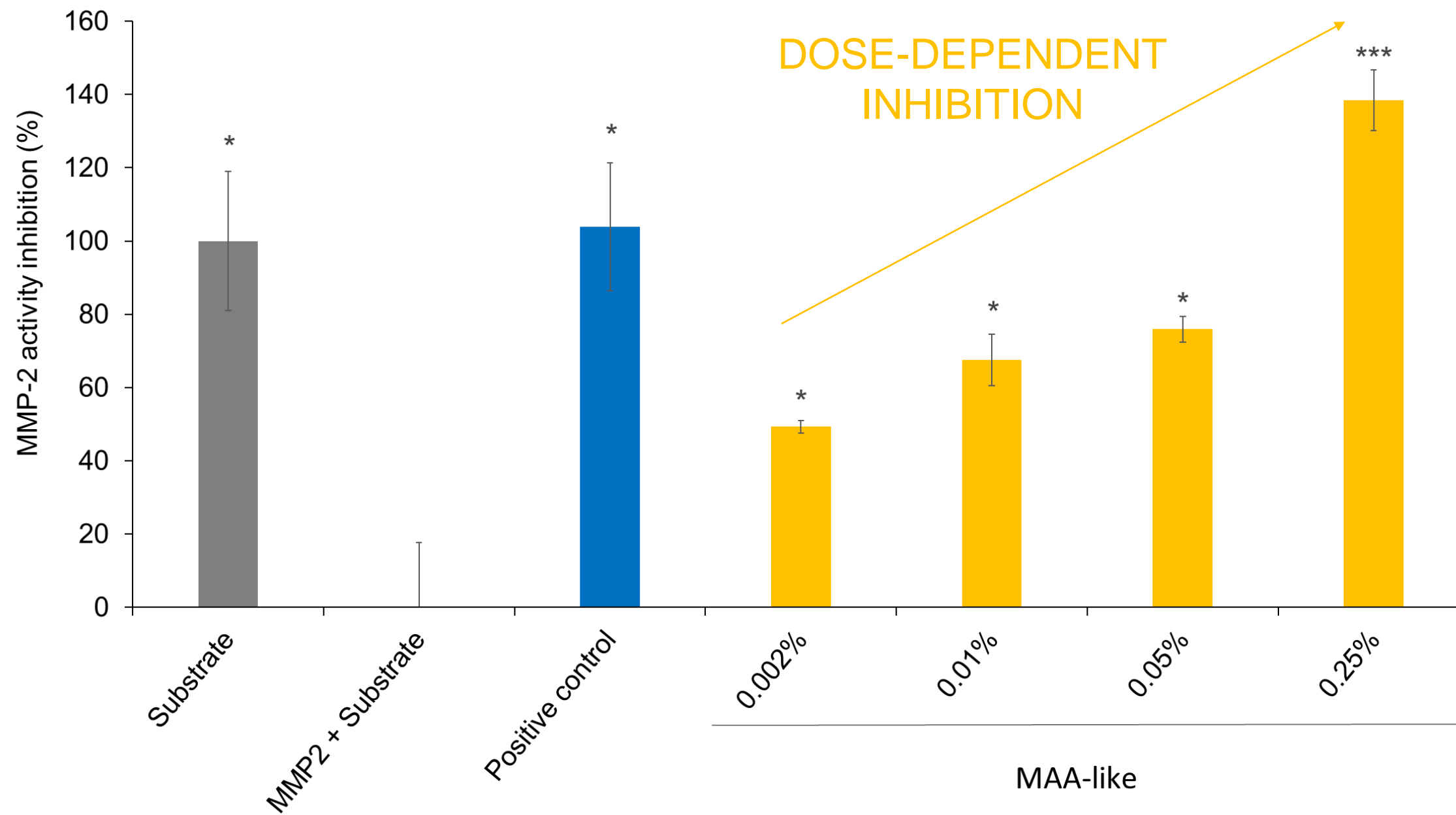
\*\*p≤0.01, \*\*\*p≤0.001  
Student test

§0.1% MAA-like = 0.15% Vitamin E (equimolar)

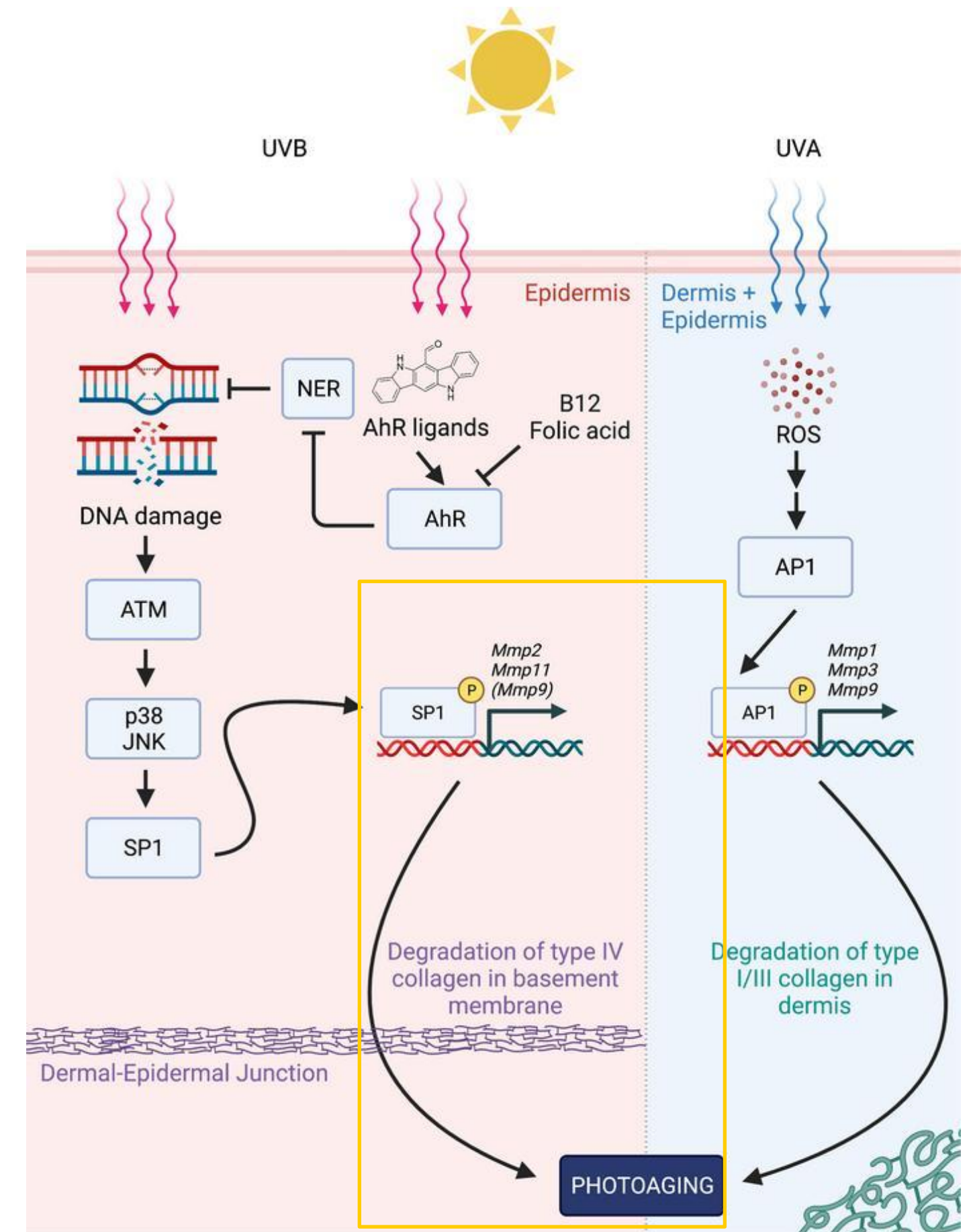
ORAC = Oxygen Radical Absorbance Capacity

The ecobiology MAA-like is antioxidant.

# Anti-aging properties: MMP-2 activity



\*p≤0.05, \*\*\*p≤0.001, Student test



from Kim D.J. et al, JCI Insight 2022;7(9):e156344

The ecobiology MAA-like inhibits MMP-2 activity involved in photoaging.



**To go further...**

**At the level of the aquatic ecosystems**



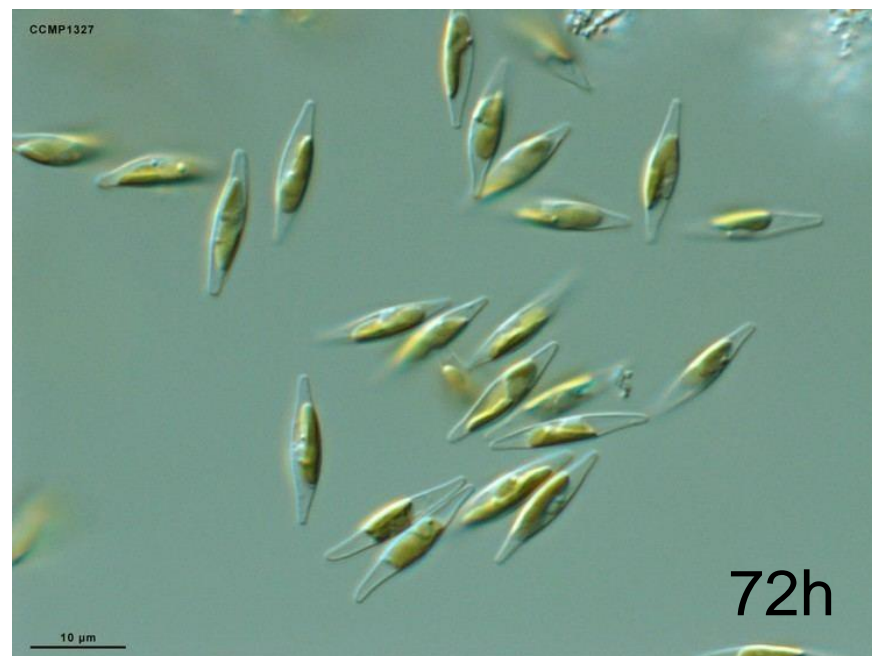


# Ecotoxicological tests on the finished product



## Marine ecosystem

Marine algal growth inhibition test  
(NF EN ISO 10253)



*Phaeodactylum tricornutum*\*

Phytoplankton

Fragment bleaching and polyp retraction on Cnidaria Coral  
(Eurofins' method)



*Seriatopora hystrix*

## Freshwater ecosystem

Daphnids acute immobilization test  
(OCDE 202 – April 2004 method,  
NF EN ISO 6341-2012)



*Daphnia magna*\*

Zooplankton

No effect of the finished product in these 3 tests.

# Conclusion on an ecobiological MAA-like



Launch spring 2024

» Ecobiology is an original approach that considers the **skin as an ever-evolving ecosystem in relation with its environment**, whose natural resources and mechanisms must be preserved.

» Ecobiological MAA-like:

- is **pure synthetic molecule** with similar chemical structure **inspired by MAA**, natural photoprotector in many organisms;
- **preserves and reinforces the skin ecosystem from photoaging**: photoprotection, antioxidative (UVA), anti-MMP-2 (UVB) properties.

» Formulated in a sunscreen with a **reduced ecotoxicity on the aquatic ecosystem**.



# Acknowledgments



- Nicolas DELPONT
- Sophie WEBER
- Amélie GENET
- Clémence JANNIOT
- Cécile GARIN
- Emmanuelle GUISSART

- Arnaud FONTBONNE
- Baba TEME
- Julie FITOUSSI
- Sandra TROMPEZINSKI
- Santana THACH
- Noëlle REMOUE
- Elodie VALIN

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THANK YOU FOR YOUR ATTENTION