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A multi-omic approach to understand solar exposure impact on skin ecosystem and evaluate a new SPF50+ sunscreen efficacy

Carine Jacques, Daniel Bacqueville, Emilien Jamin, Martine Maitre, Anais Noustens, Aimée Simcic-Mori, Cécile Delsol, Laurent Debrauwer, Sandrine Bessou-Touya, Hélène Duplan

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EAU THERMALE
Avène

A multiomic approach to understand solar exposure impact on skin ecosystem and evaluate a new SPF50+ sunscreen efficacy

Carine Jacques-Jamin



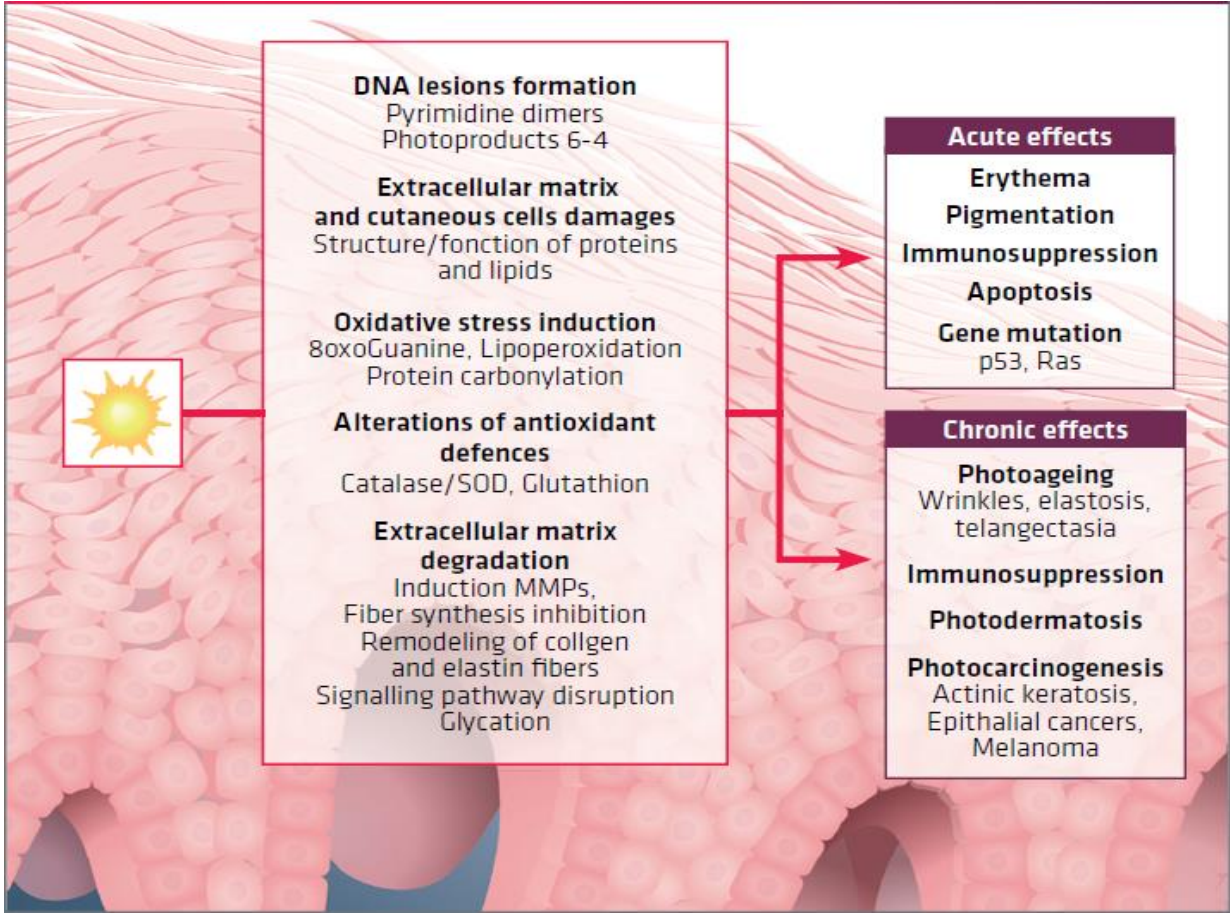
20th Congress of the European Society for Photobiology

August 27 – 31, 2023 Lyon, France



Pierre Fabre
Dermo-Cosmétique
& Personal Care
Recherche & Développement

❖ Over-exposure to sunlight induces skin alterations especially UV radiations



❖ Photoprotection is now a major issue in public health to prevent sun damage including photoaging and cancer

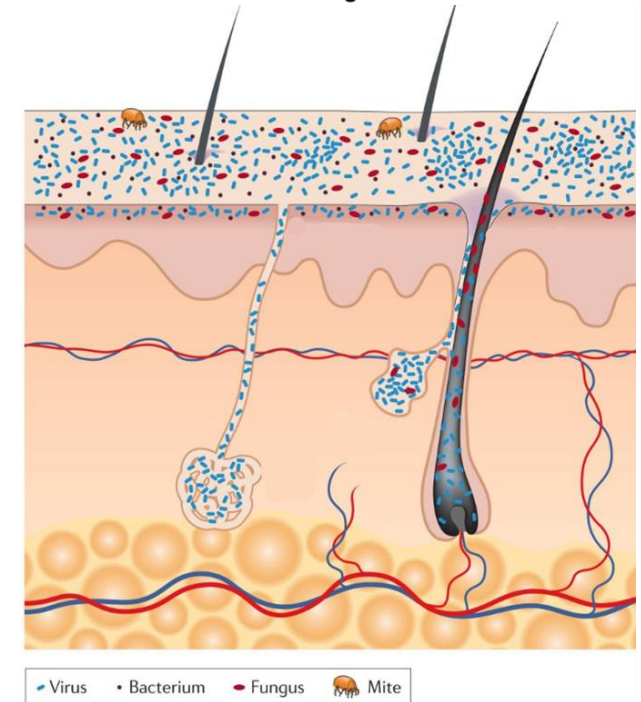
Skin ecosystem and Sun-exposure

- ❖ Skin has its own unique ecosystem consisting of millions of bacteria, fungi, and viruses.
- ❖ The composition of these communities depend on skin characteristics, host and environmental factors.
- ❖ Skin microbes may contribute to noninfectious pathologies like atopic dermatitis, psoriasis, rosacea and acne.
- ❖ Skin microbes tend to maintain a state of equilibrium, thereby protecting the host from microbial pathogens.

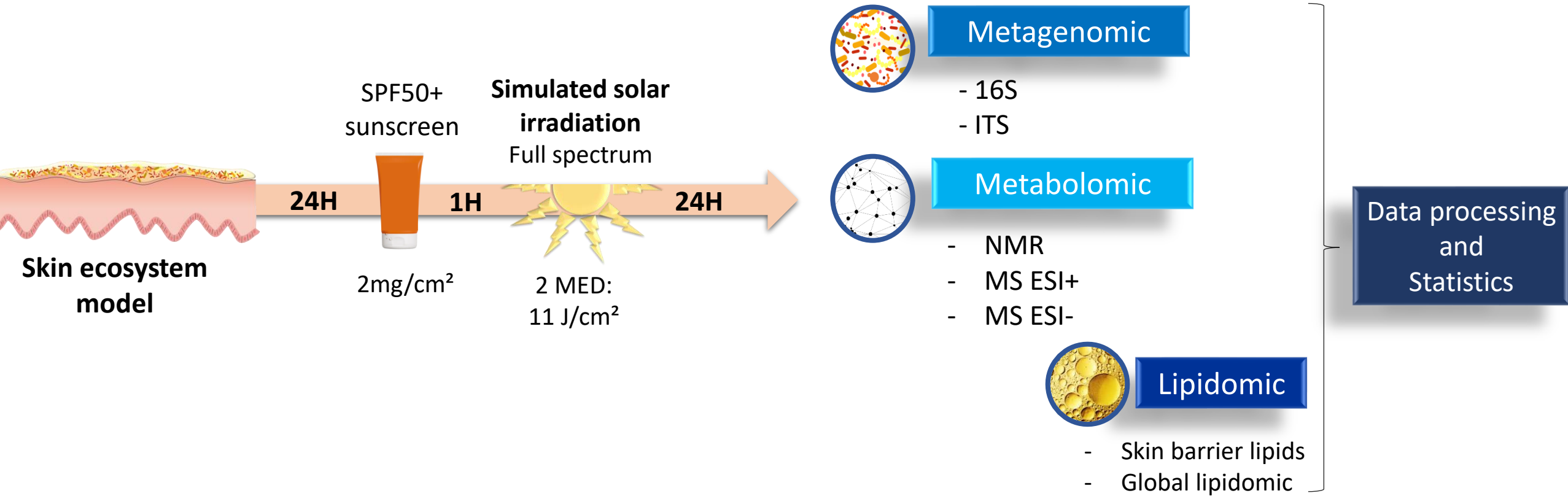
Nat Rev Microbiol. 2011 April ; 9(4): 244–253. doi:10.1038/nrmicro2537.

The skin microbiome

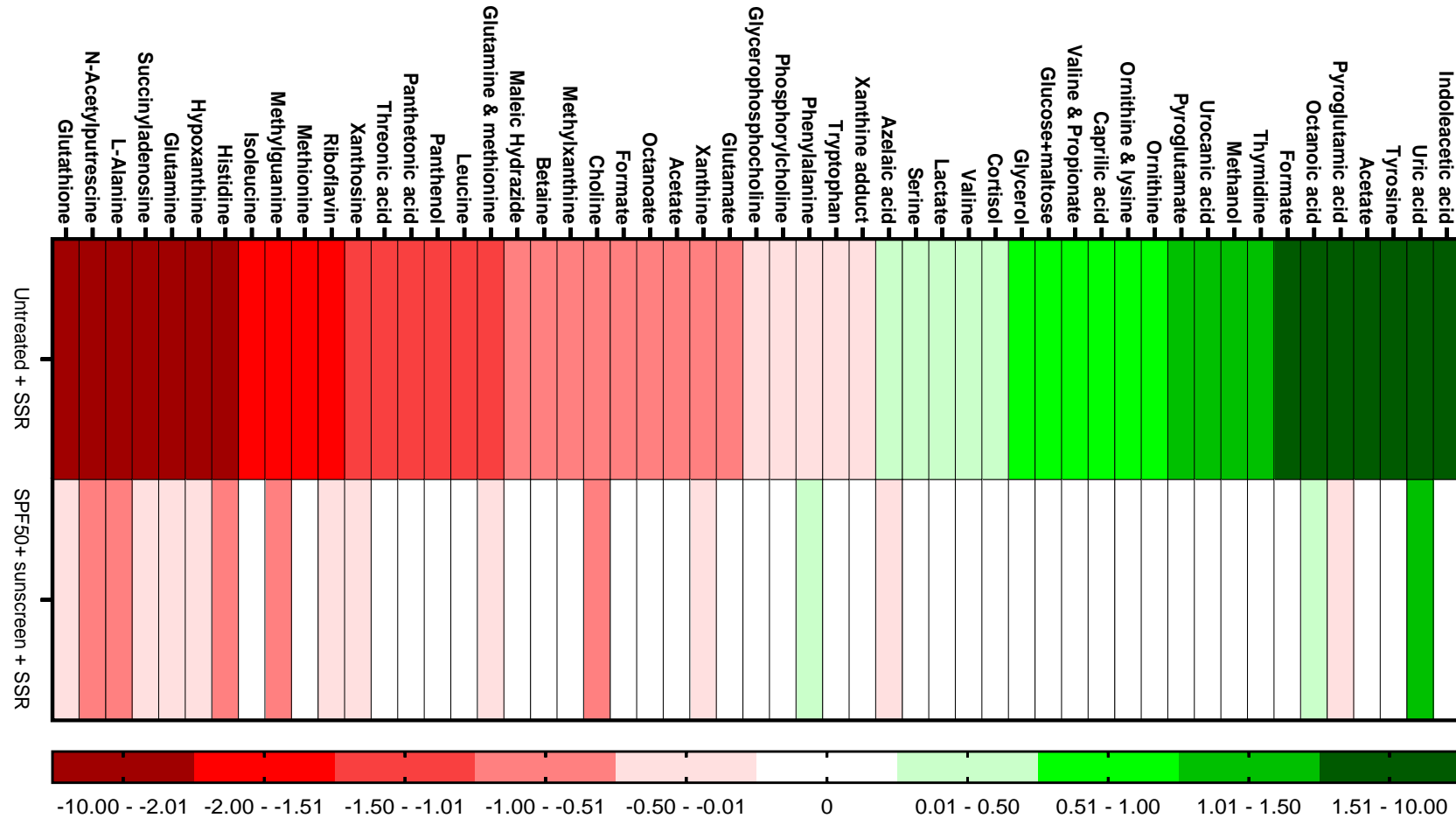
Elizabeth A. Grice and Julia A. Segre



❖ Impact of sun-exposure on skin ecosystem (skin, SSL and microbiota)



Metabolomic analysis

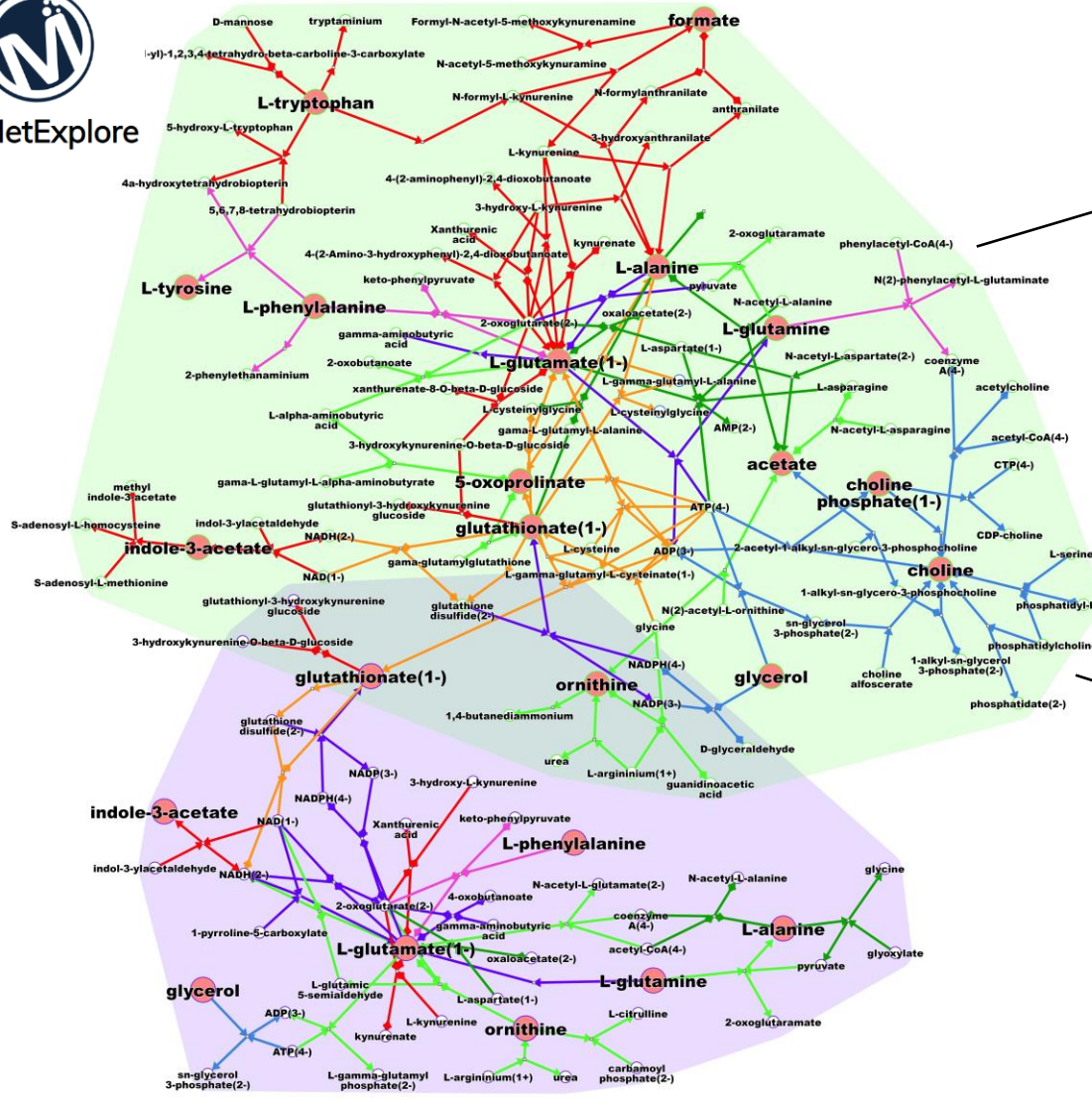


❖ Up to 50 metabolites modulated with SSR, SPF50+ sunscreen prevents major metabolic modulations

Metabolomic analysis



MetExplore



Name	Bonferroni corrected p-value
Alanine and aspartate metabolism	2,53E-04
Glutathione metabolism	9,83E-04
Glycerophospholipid metabolism	1,42E-03
Glutamate metabolism	2,60E-03
Pyruvate metabolism	3,82E-03
Phenylalanine metabolism	8,36E-03
Urea cycle	9,32E-03
Valine, leucine, and isoleucine metabolism	2,68E-02

Biological effects of SSR

- Oxidative stress
- Inflammation
- Immuno-modulation
- Alteration antioxidants

	Sun exposure	Sun exposure_SPF50+
Uric acid	2,41	1,25
Xanthine adduct	-0,24	ns
Xanthine	-0,53	-0,16
Xanthosine	-1,438	-0,45
Methylxanthine	-0,7	ns
Methylguanine	-1,86	-0,91
Hypoxanthine	-2,38	-0,46
Glutamine & methionine	-1,01	-0,27
Glutathione	-9,12	-0,255
L-Pyrroglutamic acid	1,80	ns
Serine	0,34	ns
Methionine	-1,53	ns
Glutamate	-0,53	ns
Thymidine	1,50	ns

Fold changes (log2) for significant metabolites

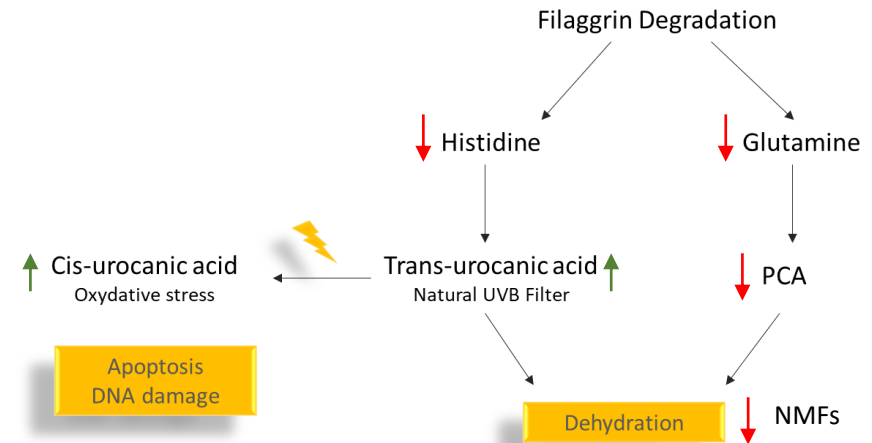
• The skin goes to catabolism rather than anabolism pathway and produces higher oxidative stress

New insights: Barrier Function

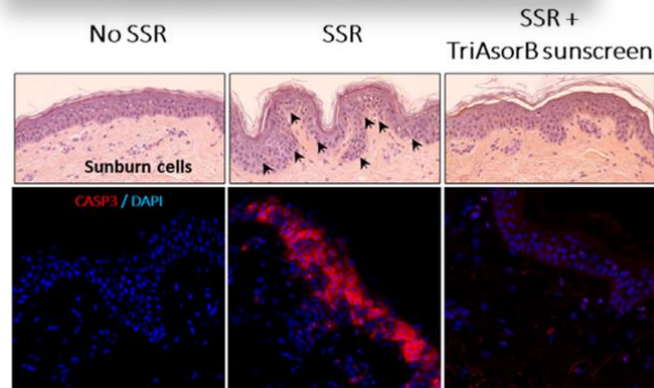
Metabolomic data

	SSR exposure	SPF50+_SSR exposure
Acetate	1.80	ns
Acetate (surface)	-0.53	
Alanine	-3.27	-0.94
Choline	-0.61	-0.82
Choline (surface)	0.72	ns
Glutamate	-0.52	ns
Glutamine	-2.67	-0.21
Glycerophosphocholine	-0,5	
Histidine	-2.06	-0.9
Lactate	0.44	ns
Methylxanthine	-0.8	ns
Ornithine	0.95	ns
Ornithine & lysine	0.88	ns
Panthenol (surface)	-1.18	ns
Phosphorylcholine	-0.41	ns
Pyroglutamate	1.15	ns
PCA	-1.8	-0.07
PCA (surface)	0.86	ns
Serine	0.34	ns
Succinyladenosine	-2.86	-0.22
Urocanic acid	1.2	ns

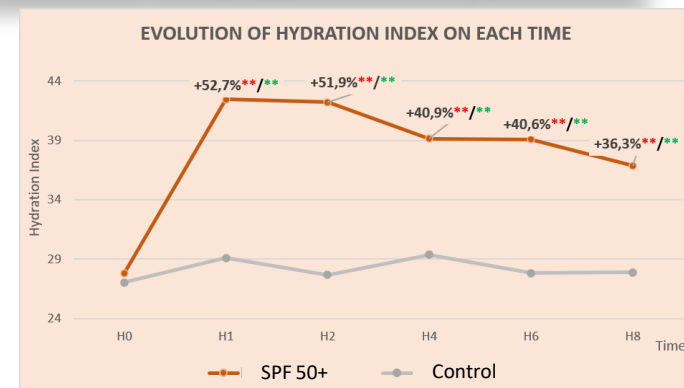
Fold changes (log2) for discriminant and significant metabolites (VIP >1, p-value < 0.05)



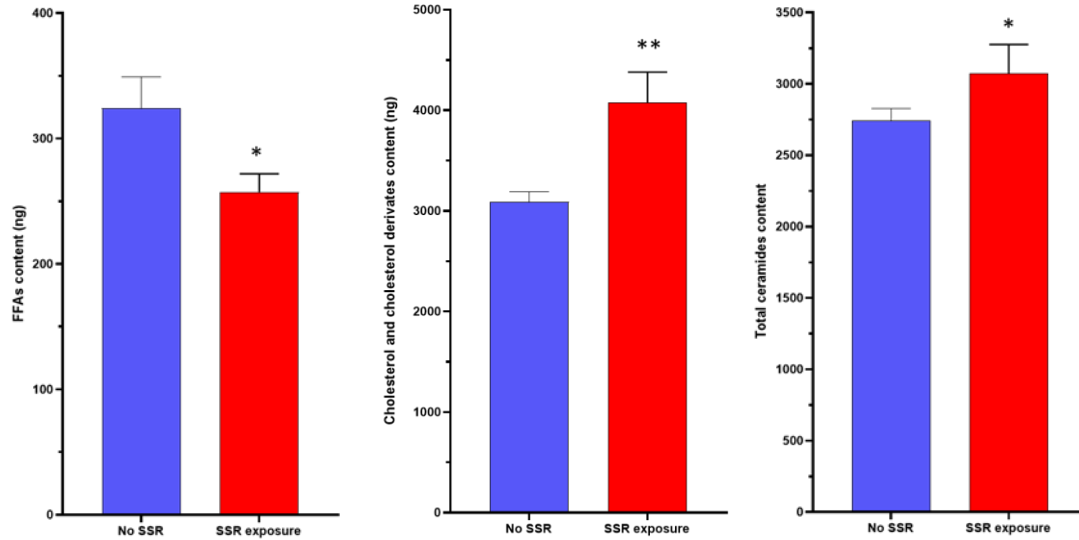
Apoptosis – In vitro



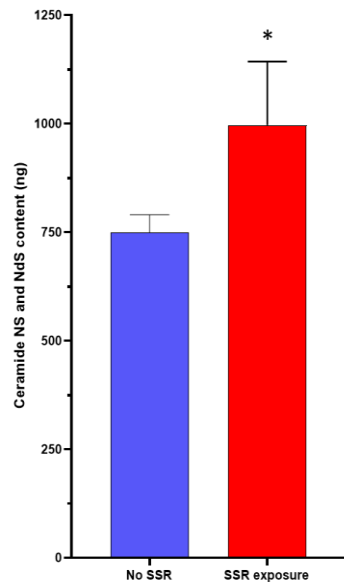
In vivo - Evaluation of hydration



New insights: Barrier Function



Lipids in stratum corneum of reconstructed epidermis
(Mean \pm SEM, n=9, * pvalue < 0.05, ** pvalue < 0.01)



Increase of ceramides content
driven by Cer [NS and Nds]

- ❖ Involved in inflammatory pathologies like AD
- ❖ Biomarker of barrier function alteration

- ❖ Decrease of FFAs
- ❖ Increase of total ceramides: apoptosis
- ❖ Increase of cholesterol derivatives: photoaging

Contents lists available at ScienceDirect

Journal of Steroid Biochemistry & Molecular Biology

ELSEVIER journal homepage: www.elsevier.com/locate/jsmb

Review

Lipid deregulation in UV irradiated skin cells: Role of 25-hydroxycholesterol in keratinocyte differentiation during photoaging

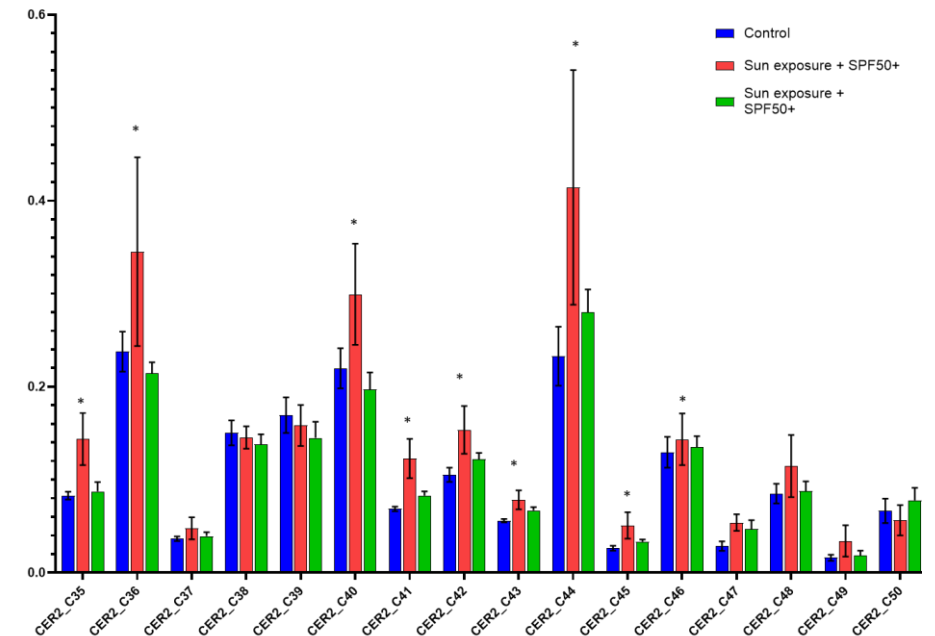
Elodie Olivier^{a,b}, Mélody Dutoit^{a,c}, Anne Regazzetti^a, Delphine Dargère^a, Nicolas A. Olivier Laprèvote^a, Patrice Rat^{a,*}

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Alteration to the Skin Barrier Integrity Following Broad-Spectrum UV Exposure in an Ex Vivo Tissue Model

Rebecca Barresi, Emily Chen, I-Chien Liao PhD, Xue Liu PhD, Nada Baalbaki PhD, Stephen Lynch PhD, Patricia Brieve PhD, Miao Wang, Qian Zheng MD PhD, Charbel Bouez PhD



Alterations of microbial host interactions

Metabolomic data

	SSR exposure	SPF50+_SSR exposure
Glutamate	-0.52	ns
Indolelactic	2.7	ns
Isoleucine	-1.86	ns
Leucine	-1.03	ns
Phenylalanine	-0.36	0.20
<i>Phenylalanine (surface)</i>	0.82	ns
Succinyladenosine	-2.86	-0.22
Thymidine	1.5	ns
Tryptophan	-0.36	ns
Tyrosine	2.32	ns
<i>Tyrosine (surface)</i>	0.93	ns
Valine	0.5	ns
Propionate	0.7	ns

Fold changes (log₂) for discriminant and significant metabolite (VIP >1, p-value < 0.05)



- ❖ Metabolism Pathways
 - Phenylalanine, tyrosine, and tryptophan metabolism
 - Tryptamine pathway
 - Branched-chain amino acid metabolism

Jacques et al, Photochem and Photobiol 2023

Metagenomic data

Control – ITS



SSR exposure – ITS



- ❖ Tryptophane metabolism is correlated to Malassezia genus
- ❖ Play a role on inflammation and immunomodulation

Alterations of microbial host interactions

Metabolomic data

	SSR exposure	SPF50+_SSR exposure
Glutamate	-0.52	ns
Indolelactic	2.7	ns
Isoleucine	-1.86	ns
Leucine	-1.03	ns
Phenylalanine	-0.36	0.20
<i>Phenylalanine (surface)</i>	0.82	ns
Succinyladenosine	-2.86	-0.22
Thymidine	1.5	ns
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Tyrosine	2.32	ns
<i>Tyrosine (surface)</i>	0.93	ns
Valine	0.5	ns
Propionate	0.7	ns

Fold changes (\log_2) for discriminant and significant metabolite ($VIP > 1$, $p\text{-value} < 0.05$)



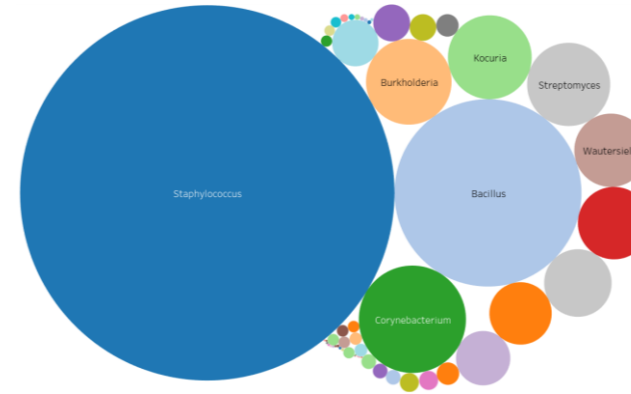
Metabolism Pathways

- Phenylalanine, tyrosine, and tryptophan metabolism
- Tryptamine pathway
- Branched-chain amino acid metabolism

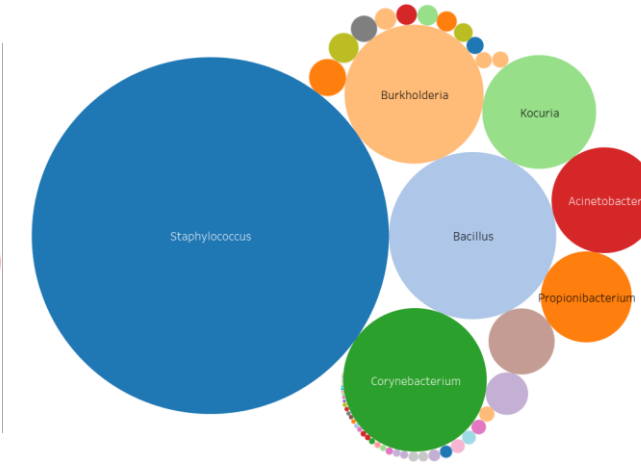
Jacques et al, Photochem and Photobiol 2023

Metagenomic data

Control – 16S



SSR exposure – 16S



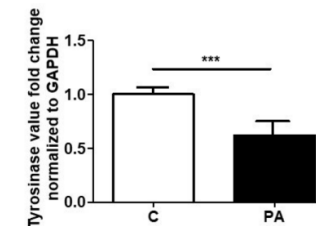
- ❖ Propionate correlated with Cutibacterium genus

frontiers
in Microbiology

ORIGINAL RESEARCH
published: 28 October 2020
doi: 10.3389/fmicb.2020.565549

New Insights Into the Skin Microbial Communities and Skin Aging

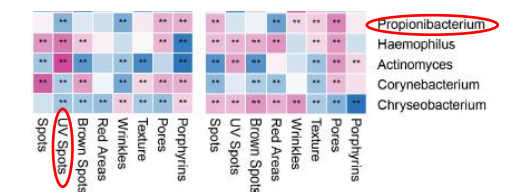
Zichao Li^{1*}, Xiaozhi Bai^{1*}, Tingwei Peng^{2*}, Xiaowei Yi¹, Liang Luo¹, Jizhong Yang¹, Jiagi Liu¹, Yunchuan Wang¹, Ting He¹, Xujie Wang¹, Huayu Zhu¹, Hongtao Wang¹, Ke Tao¹, Zhao Zheno¹, Linlin Su^{1*} and Dahai Hu^{1*}



scientific reports

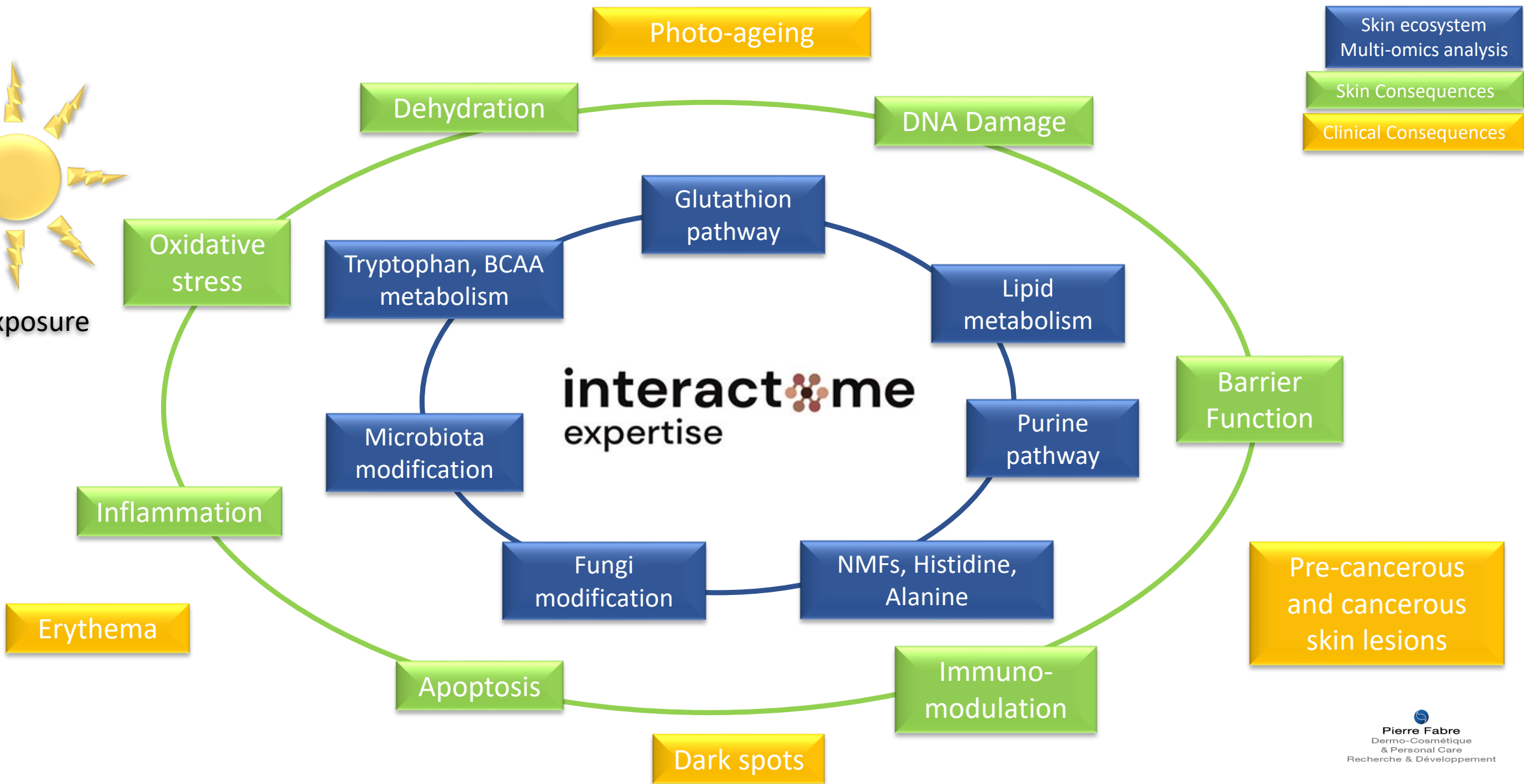
Propionic acid produced by *Cutibacterium acnes* fermentation ameliorates ultraviolet B-induced melanin synthesis

Hsin-Jou Kao¹, Yan-Han Wang², Sunita Keshari³, John Jackson Yang³, Shinta Simbolon⁴, Chun-Chuan Chen⁵ & Chun-Ming Huang^{1*}





Sun exposure



Thank you for your attention !



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Hélène Duplan*



*Emilien L. Jamin
Isabelle Jouanin
Jean-François Martin
Laurent Debrauwer*



*Maxime Manno
Marina Moletta-Denat
Esther Jausseme*



*Gilles Frache
Maureen Feucherolles
Jérôme Bour
William LE*



*Camille Boudet
Gautier Doat*



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